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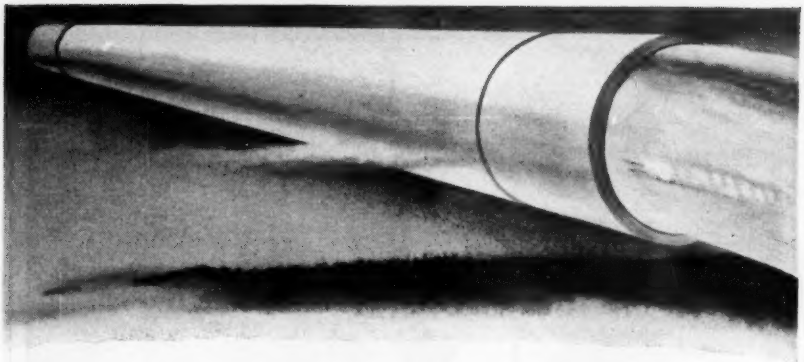
Baltimore's Battle Monument to her heroic dead in the War of 1812, as it looked 100 years ago.



COMING MEETINGS

February **7–9**—Indiana Section at Lincoln Hotel, Indianapolis. Secretary: G. G. Fassnacht, 366 Good Ave., Indianapolis 19.

15—New Jersey Section Winter Luncheon Meeting at Hotel Essex House, Newark. Secretary: C. B. Tygert, Box 178, Newark 1.

March **16**—New England Section at Hotel Statler, Boston, Mass. Secretary: G. G. Bogren, Weston & Sampson, 14 Beacon St., Boston 8.

28–30—Illinois Section at La Salle Hotel, Chicago. Secretary: J. L. Hart, Asst. Western Sales Mgr., U.S. Pipe & Foundry Co., 122 S. Michigan Ave., Chicago 3.

April **5–6**—New York Section at Hotel Ten Eyck, Albany. Secretary: R. K. Blanchard, Vice-Pres., Neptune Meter Co., 50 W. 50 St., New York 20.

11–13—Kansas Section at Lamer Hotel, Hays. Secretary: H. W. Badley, Neptune Meter Co., 640 Highland St., Salina.

19–20—Nebraska Section at Cornhusker Hotel, Lincoln. Secretary: E. Bruce Meier, Dept. of Civ. Eng., University of Nebraska, Lincoln.

20–21—Montana Section at Placer Hotel, Helena. Secretary: A. W. Clarkson, Asst. Director, Div. of San. Eng., State Board of Health, 1036 Eighth Ave., Helena.

A.W.W.A. 1951 ANNUAL CONFERENCE
Miami, Fla., April 29—May 4

Reservation forms have been mailed to all members and all reservations will be cleared through the A.W.W.A. office. The hotels have agreed to accept no reservations for the 1951 Conference except as they are requested on the standard form provided by the A.W.W.A.

71st Annual Conference

May **17–19**—Pacific Northwest Section at Vancouver Hotel, Vancouver, B.C. Secretary: O. P. Newman, Secy., Boise Water Corp., Boise, Idaho.

21–23—Canadian Section at Royal Alexandra Hotel, Winnipeg, Man. Secretary: A. E. Berry, Ontario Dept. of Health, Parliament Bldgs., Toronto 2, Ont.

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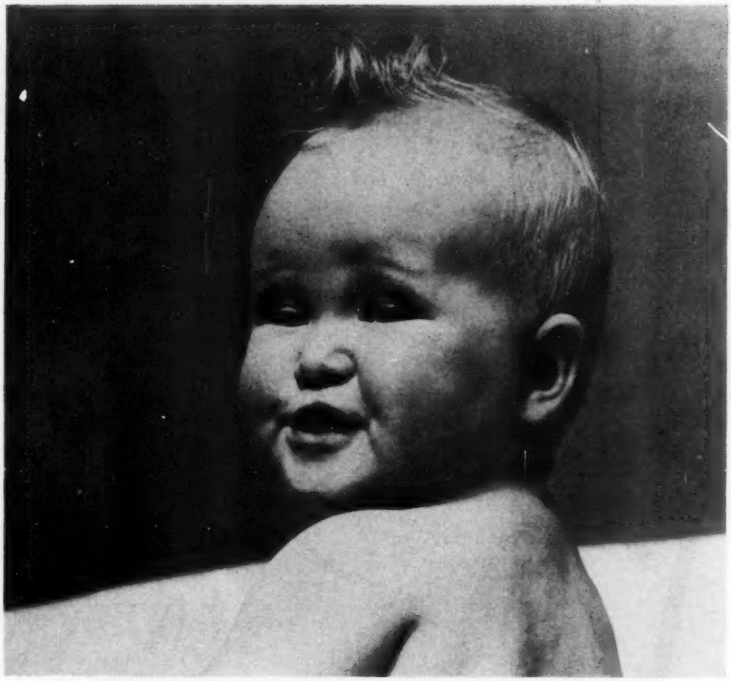

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Contents

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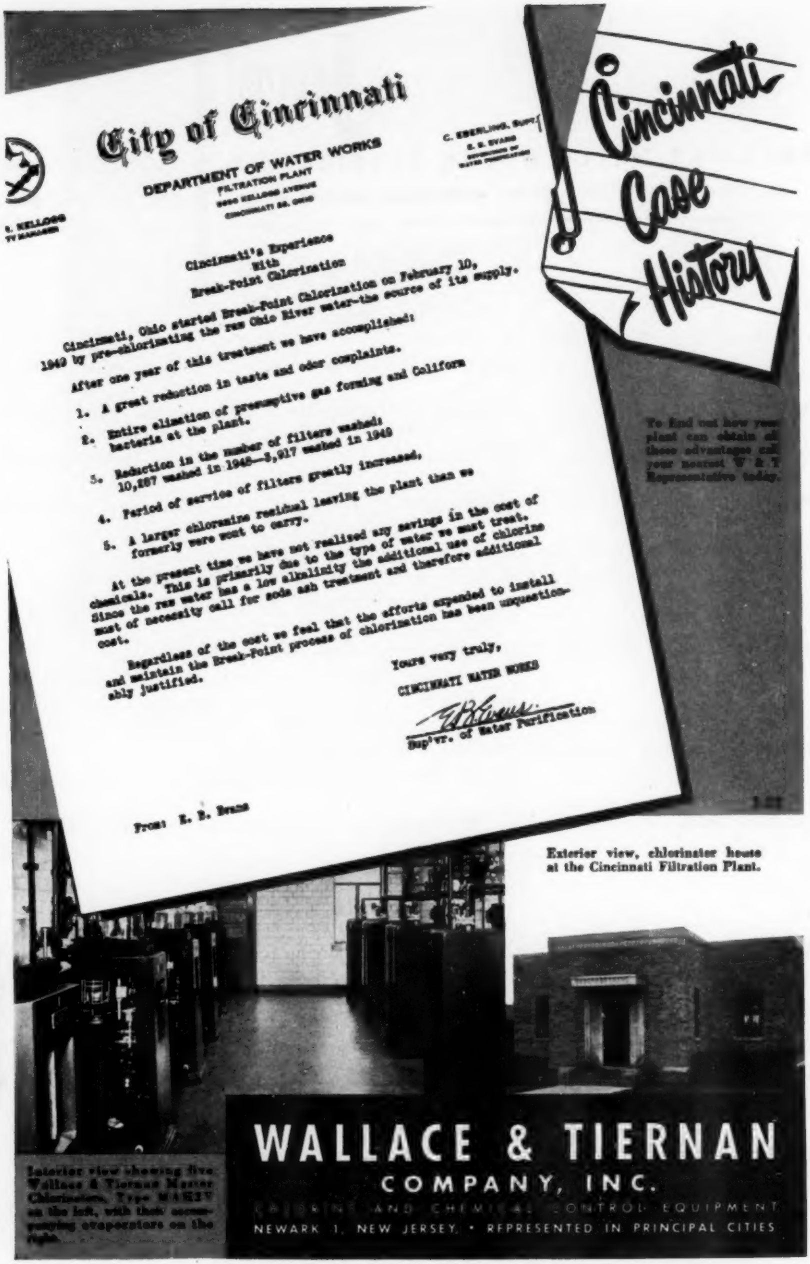
City of Cincinnati
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With
Break-Point Chlorination
Cincinnati, Ohio started Break-Point Chlorination on February 10, 1949 by pre-chlorinating the raw Ohio River water—the source of its supply.
After one year of this treatment we have accomplished:
1. A great reduction in taste and odor complaints.
2. Entire elimation of presumptive gas forming and Coliform bacteria at the plant.
3. Reduction in the number of filters washed: 10,287 washed in 1948—3,917 washed in 1949
4. Period of service of filters greatly increased.
5. A larger chloramine residual leaving the plant than we formerly were wont to carry.
At the present time we have not realized any savings in the cost of chemicals. This is primarily due to the type of water we must treat. Since the raw water has a low alkalinity the additional use of chlorine must of necessity call for soda ash treatment and therefore additional cost.
Regardless of the cost we feel that the efforts expended to install and maintain the Break-Point process of chlorination has been unquestionably justified.
Yours very truly,
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Sup'vr. of Water Purification
From: E. B. Evans
To find out how you
plant can obtain a
these advantages ca
your nearest W & T
Representative today.
Exterior view, chlorinator house at the Cincinnati Filtration Plant.
Interior view showing five Wallace & Tiernan Master Chlorinators, Type MAKIV on the left, with their accompanying evaporators on the right.
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Journal
AMERICAN WATER WORKS ASSOCIATION
VOL. 43 • FEBRUARY 1951 • NO. 2

A Water Policy for the American People

President's Water Resources Policy Commission

A summary of recommendations from the report of the President's Water Resources Policy Commission, published in December 1950 by the U.S. Government Printing Office, Washington, D.C. The report itself is in three volumes: Vol. 1—General Report; Vol. 2—Ten Rivers in America's Future; and Vol. 3—Water Resources Law.

AMERICA is a country richly endowed with natural resources: fertile land, extensive and varied forests, an abundance of mineral wealth beneath the soil. All these things are gifts of nature, which our people have used to build a civilization unmatched in human history for its material productivity. From the products of our land, our forests, our mines and oil fields, we have raised great cities and spanned a continent with railroads and automobile highways. But without one key resource, water, none of these miracles of human achievement would have been possible.

Water has unique characteristics. Time does not change it. It is the same today as it was 10,000 years ago. Water is active, and affects all other things. It has molded our mountains, carved our great valleys, nourished our forests, created our alluvial plains, played a major part in creating the fertility of our land and carried off our topsoil. Changes in its quality are only temporary; it does not change in quantity but only in its location and form as it pursues nature's eternal cycle from the raindrop to the land, thence to the sea and back again to the clouds.

Throughout history, water has dominated human life. The earliest civilizations appeared in the great river basins of Mesopotamia and Egypt. Settlements were limited to coastlines and river banks; trading centers arose at the confluences of navigable streams. Rainfall and drought have set the stage for the drama of human existence. Rivers, with their life-giving waters, changing at times to swollen monsters bent on destruction, have been principal actors in that drama.

Until recent times, man has not attempted to control water, except in a limited measure for water supply and

irrigation. He has for the most part been forced to adjust his ways to its vagaries as nature gave or withheld rain for his crops or overwhelmed him with raging floods. Prayer, magic and propitiation marked his early gropings for control.

Today, on the American continent, centuries of human history coexist. On their western lands, Indian rainmakers dance their age-old dances while, overhead, airplane pilots are seeding the clouds.

The attempt to use science and technical skill to force water from the clouds is symbolic of the modern determination to control and use water rather than to submit to it.

It is an expression of the same scientific determination to use the forces of nature to serve man's purposes as is embodied in such great river basin programs as that for the Columbia, which will ultimately provide 50,000,000 hp. and bring millions of new acres under cultivation.

In the brief span of a century and a half, American farms and cities have spread over the land from the Appalachians to the Pacific. Great harbors have been built, navigable streams maintained and improved; large cities have been supplied with adequate quantities of pure domestic water, their wastes carried away by more water; in the arid and semiarid West, deserts have been made to bloom; and large and small dams provide for flood control, hydroelectric power and irrigation. All these things are the achievements of human ingenuity and enterprise—the work of many pioneering individuals, many men of technical skill, and the cooperation of local, state and federal governments.

On the debit side, man's activities in exploiting nature also have been destructive. We have used water badly, without proper respect for its natural cycle, turning it from a friend to an enemy. We have destroyed forests, leaving barren, denuded mountainsides from which rain water and melting snow pour unchecked; we have overplowed and overgrazed our lands; we have dangerously increased soil erosion, allowing precious topsoil to be carried to the sea, muddying our streams, filling up our reservoirs and increasing the damage from floods.

We Must Conserve and Develop

These are serious wastes. If they continue unchecked, they will impoverish us and our children. But it is the strength of a free society that it can recognize and correct its mistakes. It is dynamic and flexible. In all parts of the country—among engineers, conservationists, farmers, householders and other ordinary citizens—there is a growing recognition that we must conserve and develop, as well as use, our natural resources. And in conservation and development, as in use, water is the key resource.

Now, midway in the twentieth century, two facts have become compellingly clear.

The first is that water is limited in relation to the many and varied needs for its use. These needs will grow in size and complexity as the population grows and as industry develops. More water for domestic use is needed by our growing towns and cities. More water must be used to bring new lands into production in the West. New industrial techniques, such as those developed in the chemical industries, synthetic fuel production and the harnessing of atomic power, bring with them increasing demands for water.

We can no longer be wasteful and careless in our attitude toward our water resources. Not only in the

West, where the crucial value of water has long been recognized, but in every part of the country, we must manage and conserve water if we are to make the best use of it for future development.

The second fact we can now see clearly is that the management, conservation and use of our water resources are inextricably bound up with the management, conservation and use of our land and that both are essential to our expansion as a nation. Floods cannot be controlled by building higher and higher levees, or permanently by building dams, if other things are neglected. The big streams are fed by small streams, and water control inevitably leads us back to the proper conservation of forests and agricultural land.

The farmer who holds the rain water by terracing his fields, the group of farmers who band together to form a soil conservation district, play an indispensable role in water management. The preservation of our forests, our mountain lakes and streams and our wildlife sanctuaries has ample justification in providing healthful sport and recreation for the refreshment of the human spirit; but it is also an essential part of water conservation and management. In short, if we do not manage and conserve water, we suffer losses, some of them irreparable, in our other natural resources. If we do not manage and conserve these other resources, we shall lose the usefulness of our water: it will rush to the sea, robbing instead of enriching us.

The Source of Policy

A well rounded national water resources policy to meet this need must be a broad reflection of the lives of the people on their farms, in their villages and cities, in their regions and in the nation as a whole. Civilizations are built on a combination of water, land and people. When the combination ceases to be infused with a moral relationship between man and man, and man and nature, civilizations decline and give place to new combinations of these elementary values.

The people will drink the water, use it on the land to grow crops, feel the destructive power of uncontrolled floods, learn to use water more intelligently to avoid destruction of the land. They will transport their bulk cargoes on the bosom of streams, perform a multiplicity of tasks with the aid of electric power generated by falling waters, utilize water in their industrial processes, resent its pollution, and enjoy the fishing, boating, swimming and other forms of recreation offered by the clean waters of lakes, reservoirs, ponds and streams.

So it is the people that a nation's water resources policy must be designed to serve. In a democracy such a policy is simply the way in which the people decide, through their local, state and federal governments, to utilize water for all these purposes.

Natural Subdivisions

River basins are the natural subdivisions of our water resources, and watersheds are the natural units in these river basins. Therefore, water resources policy will tend to deal with the ways and means of deciding how best to preserve and utilize the resources of watersheds and river basins. People who live in these communities must learn to share in the cooperative application of sound policy to the development of water resources within the basin.

From the pioneering days in which our nation was born, people have thought in terms of the rivers that were so important in establishing the

geographic, economic and social characteristics of their culture. The many rivers of New England not only contributed to its beauty but turned the wheels of the country's earliest manufacturing plants. The rivers of the Middle Atlantic States not only energized their industries but carried increasing burdens of commerce.

The rivers of the South Atlantic and Gulf areas carried commerce and wove themselves into the cultural life of the people. Among these, the Misissippi, with its great Missouri, Ohio, Tennessee and Arkansas tributaries, served and gave character to the entire heart of the continent. Along its many waters, pioneers moved to build a continental nation.

Farther west, where the country becomes more arid, the rivers have been vital sources of water, sustaining the development of agriculture and establishing the necessary foundation for the development of many states. Especially the three great basins of the West—the Columbia, Sacramento–San Joaquin and Colorado—have become the fundamental sources of strength for rich regional cultures.

New Problems

With the development of the nation in the great river valleys which gave form to regions, the relationship of people to rivers became more complex, raising new possibilities of use, new problems of conservation and new necessities for controlling their water. The river made its contribution to a simple regional economy without asking elaborate programs or heavy investment. It was simply a matter of small dams for mechanical power in the headwater streams, piers for small boats wherever there was a pond, lake or smooth reach of water, and docks for cargo and passenger ships in the lower reaches. Many rivers contributed significantly of their shad or salmon to the regional food supply. In the West, simple impoundments with extended systems of locally constructed gravity canals enabled the waters, contributed by melting snow on the mountains, to turn desert areas into prolific sources of foods and fibers.

But as agriculture and water use developed with the rise of our city civilization, the need for watershed management became more apparent. The steady shift of farming from horse and mule power to tractor power, and the shift of land use from pasture to cropland, were accompanied by a shift from natural to artificial fertilizers, adding to farm costs. At the same time, the farmer's economic position was unfavorable. His production was unrestricted, but the markets in which he bought and sold were more and more tightly controlled. These factors combined to encourage misuse of the soil to the point where erosion became one of the nation's most serious problems.

In the same period the rise of the railroads, affording areas without water transportation access to river, lake and ocean ports, ushered in a new transportation era. The growing interdependence of the entire country, characteristic of the modern commercial and industrial era, led to a tremendous increase in the demand for economical transportation. As far as waterways were concerned, the traditional shallow-draft river and canal became obsolete. A modern system of deep waterways became necessary to transport bulk commodities long distances at the lowest possible costs. The need for waterway improvement became urgent.

Similarly, the tendency of commercial and industrial centers to push their structures, and the location of railroad tracks which join them, down into the natural flood plains of rivers tended to create a major problem of protection every time a river, swelled by melting snow or torrential rains, overflowed its banks. The need for flood control appeared critical.

Meanwhile, the expanding cities and industrial plants began to overload the streams with their wastes, thus causing pollution which gradually rendered them unfit for beast, bird, fish or man. Water treatment and pollution control became imperative.

Electric power gave the final impetus to the transition to our modern industrial economy. Each tumbling rapids or waterfall on a stream, whether large or small, became a source of the great energy of modern times, electricity. In the early years nonfederal interests developed the most economical water power sites, constructing projects designed for the single purpose of producing and selling hydroelectric power. But a rising recognition of the many purposes which dams and reservoirs could serve and the approach of the time when huge water power potentials could be tapped only through federal multiple-purpose basin undertakings led to the development of federal power policy as an integral part of water resources policy.

Healthy Regionalism

These changes paralleled the ending of the free-land, pioneer stage which opened up the continent. With its ending, a new regionalism began to develop as an economic revolt against the centralization of industrial and commercial wealth in older northern states. It was directed at the tendency to restrict the new regions to a semicolonial, low per capita income, raw material–producing status. The revolt struck at all the institutional arrangements which tended to perpetuate this centralization. Particularly it found in the river basin programs a means of developing better balanced rural-industrial economies, which would increase opportunity, hold population and raise general income levels.

This new regionalism had other important objectives besides the mere correcting of economic maladjustments. Each region had its peculiar climate—products of its geography, its pioneer traditions, observances, customs and spiritual tradition and its indigenous economic activities. The people of these regions became increasingly conscious of their regional cultures as the pressure of economic centralization began, through a score of ingenious devices, to impose the cultural pattern of the metropolis, tending to obliterate regional identities. They saw a broad regional economic development which would restore a proper balance of regional opportunity and sustain the regional identity as their only hope of preserving rich regional values.

Evolution of Water Resources Policy

The rise of water resources policy to meet ever changing conditions provides one of the great examples of the effectiveness of a democratic society in meeting the widely varying needs of its people.

So, in attempting a restatement of national water resources policy, this commission feels that it is merely setting forth in an orderly fashion and perhaps carrying a step forward a policy which has developed as a result of the constructive thinking of many able

people in government agencies and departments, special commissions, congressional committees, on the floor of Congress and in the White House over a period extending back more than a century and a half.

The most important key to the evolution of that policy has been increasing recognition of comprehensive development of an entire river system for many purposes, as the means of achieving public objectives in the use of water and associated land resources. The evolution has taken policy from the earlier single-purpose, single-project approach, through the period of comprehensive single-purpose programs, including many projects in the same basin, to the present state of law governing most water resources planning. This provides for comprehensive planning, in which a number of purposes are subordinate to a specified principal purpose such as flood control, navigation or irrigation.

This commission is convinced that the next step forward must be the application of unified responsibility to the planning of multiple-purpose basinwide developments. This need not be in accordance with the Tennessee Valley Authority pattern so far as organization is concerned. But it must take advantage of what the country has learned from that experiment in unified development of the water resources of basins.

There is today no single, uniform federal policy governing comprehensive development of water and land resources. Some statutes of uniform application separately control various aspects or functions. Others are geared to a comprehensive approach, but focus attention on individual projects, specific areas or single river basins. Insofar as it may now be achieved, therefore, comprehensive development of river basins must depend upon a number of statutes passed at different times, devoted to individual segments of basin development and administered by separate executive agencies.

Efforts have been made to deal with this lack of unity through governmental reorganization. So far the recommendations along this line have not been accepted. This commission is therefore recommending the achievement of the necessary coordination through the unification of policy governing the actions of existing agencies, or of a single agency should such be adopted. This unification of policy should be assured through enactment of a single national water resources policy law controlling the activities of the government departments as presently organized or as they may be reorganized.

From Project to Program

Long before there was legislation contemplating comprehensive multiple-purpose basin programs, Congress was recognizing the interrelationships between the functions which were ultimately to compose such programs. First, it recognized the relationship between navigation and flood control in 1879; then, in 1888, the relationship between irrigation and flood control; nine years later, in 1897, the relationship between forest cover and flood control, navigation and irrigation. Finally, in 1906, the General Dam Act recognized the relationship among power, navigation and fish, while an amendment to the Reclamation Act provided for disposal of surplus power at reclamation projects.

This period culminated in a series of messages with which President Theodore Roosevelt vetoed certain bills

authorizing private development of water power and, more particularly, in the reports of President Roosevelt's Inland Waterways and National Conservation Commissions and in his letter transmitting the Waterways Commission reports to Congress. In these messages, as well as in the reports of the two commissions, the new concept of a river system as a single unit for development purposes came to the fore. In the letter transmitting the Waterway Commission report to Congress the President said:

> Every stream should be used to its utmost. No stream can be so used unless such use is planned far in advance. When such plans are met, we shall find that, instead of interfering, one use can often be made to assist another. Each river system, from its headwaters in the forest to its mouth on the coast, is a single unit and should be treated as such.

In the same letter President Roosevelt recognized that it was not "possible to deal with a river system as a single problem" because waterways were dealt with through agencies scattered through four federal departments. He called attention to the report's observation that national policy had previously been one of "almost unrestricted disposition and waste of natural resources," and that it emphasized "the fundamental necessity for conserving these resources upon which our present and future success as a Nation primarily rest."

The report of the Conservation Commission, issued in 1909, laid down a policy which can be merely amplified, not improved, in the breadth of its understanding of basic principles. It said:

> Broad plans should be adopted providing for a system of waterway improvement extending to all uses of the waters and benefits to be derived from their control, including the clarification of the water and abatement of floods for the benefit of navigation; the extension of irrigation; the development and application of power; the prevention of soil wash; the purification of streams for water supply; and the drainage and utilization of the waters of swamp and overflow lands.
>
> To promote and perfect these plans scientific investigations, surveys and measurements should be continued and extended, especially the more accurate determination of rainfall and evaporation, the investigation and measurement of ground water, the gaging of streams and determination of sediment, and topographic surveys of catchment areas and sites available for control of the waters for navigation and related purposes.

The report of the Conservation Commission was promptly approved by a Joint Conservation Conference, including governors of 20 states and territories, and representatives of 22 state conservation agencies, of 60 national organizations, of federal agencies and of the Conservation Commission itself.

But it was not until 1933, more than 20 years later, that Congress authorized a large-scale effort to treat river basins as units for purposes of development. This has developed the conflicts and confusion which always attend the effort to put new wine into old bottles. With the exception of the TVA Act, the legislative and administrative setup has not been conducive to full development of the unified basin programs which these early conservationists contemplated.

Need for Reappraisal

Meanwhile, as new needs developed and with them our understanding of the interrelationships of all aspects of land and water management, the neces-

sity to consider whole river basins with their tributaries, including the many brooks, ponds, lakes and basins of their little waters, has become increasingly apparent. The ideas of conservation, and of multiple-purpose projects, began to pose new problems of coordination, if wastes and cross-purposes were to be avoided.

Irrigation and drainage, navigation and flood control, the maintenance of underground water levels, the control of stream pollution resulting from human, animal and industrial wastes, the generation of electric power, the protection of salmon and other fish resources, the provision of ample domestic water supply—all these purposes have legitimate claims within any one basin; but if one is developed without regard for its effect on the others, conflicts and losses will result.

Comprehensive, long-range plans must be worked out within each river basin. But a river basin is still not the final unit in an adequate use and conservation plan. The federal government has a substantial investment in existing water resources improvements; it will spend in 1951 another 1.2 billion dollars; it has authorizations amounting to 12 billion dollars in the years just ahead. These expenditures will be made for the good of the nation as a whole; and nothing less than the whole country can be the unit considered in the formulation of federal policies.

It is for these reasons that the President of the United States appointed this Commission on Water Resources Policy and asked for recommendations for a comprehensive policy of water resources development, giving particular consideration to the following:

1. The extent and character of federal government participation in major water resources programs.

2. An appraisal of the priority of water resources programs from a standpoint of economic and social needs.

3. Criteria and standards for evaluating the feasibility of such projects.

4. Desirable legislation or changes in existing legislation.

Broad Considerations for Federal Policy

The President's question concerning "the extent and character of federal government participation in major water resources programs" raises immediately some basic problems of economic and social philosophy. The long-range development of our resources is a vast undertaking, affecting all aspects of American life. How great a share of this investment in the future should be financed by the federal government and what should be the division of responsibility between the many agencies of federal, state and local government, private groups and individuals are matters of proper concern to every citizen.

The broad assumption on which this report is based . . . is that of an expanding economy.

Our population is growing and will reach an estimated 190,000,000 in about 25 years. Merely to maintain our present standards of living, therefore, we shall need to husband our water resources and use them to irrigate the fields and produce the power required to meet the needs of increasing numbers of people.

But the goal of the American economy has never been static. It is, and will continue to be, dynamic. We have achieved, and expect to achieve in the future, a constantly rising standard of living for a growing population.

There are no new physical frontiers, no new lands or forests to exploit. Indeed, some of our natural resources

have been lost through careless and wasteful exploitation. Today, the problem of economic advance has been expressed as "to make more and more out of less and less." There are immense and inspiring possibilities of continued expansion and advancement; but the new frontier we must explore is not merely physical. It lies in the realms of knowledge and skill, and the wisdom with which we as a people can cooperate to apply them. We need much greater knowledge, determination and foresight than our fathers needed in order to fulfill the promise of American life. That promise is as great for us as it was for them. The wise development and conservation of our key resource, water, is essential to further economic progress.

But provision of opportunities to achieve higher levels of material well-being for a growing population is not the sole measure of federal responsibility. Even more important is the fact that on the strength and dynamism of the American economy rests the main hope of achieving world peace and freedom.

We are committeed to a titanic contest in which proper utilization of our resources may prove the ultimate determinant of our strength. All our skill, enterprise and political wisdom will be needed to meet that challenge, not only for ourselves, but in defense of human freedom everywhere.

Democratic Planning

It cannot be too strongly emphasized that planning, for the United States, must mean not rigidity, but intelligent flexibility; not dictatorship and centralization, but cooperative and shared responsibility. The American system succeeds only as it encourages initiative, enterprise and a sense of responsibility for the common good. No "plan" can be acceptable which weakens or fails to use these qualities. The recommendations of this report do indeed envisage long-range plans for each river basin and an overall water resources plan for the nation as a whole. But both in the detailed formulation of these plans and in their operation, individual farmers, workers and businessmen, as well as agencies of local, state and federal government, will play an indispensable and fully responsible part.

The federal government is clearly charged with responsibility for safeguarding and developing our resources, but it is only one of the agencies involved. Its specific role is one of leadership—the provision of relevant scientific and economic information and coordination, as well as a public investment function on behalf of the entire nation. These functions aid and supplement, but can never supplant, the work of local individuals and groups directly concerned.

When multiple-purpose dams are built with federal funds, the federal government enters the field of economic enterprise. The justification for this is beyond question. No other agency can command sufficient capital resources or provide the coordination necessary for the construction of these great programs. But government enterprise does not in any way supplant private enterprise. Rather its purpose is to create the overall conditions, the framework, in order to provide the opportunity for the further expansion and healthy functioning of a free, competitive economy.

In other words, "planning" in the American sense means planning to maintain and strengthen free competition. Where natural monopolies exist, therefore, it is in accordance with the American system that the government

should itself provide competition, if this is deemed necessary to insure its benefits, as for example by providing low-cost and abundant power. But it is not in accordance with the American system, nor is it any part of the purpose of the plans for water development proposed in this report, that the federal government should itself become a great monopolist.

The Economic Responsibility of the Federal Government

The sums which the federal government has already invested and will in the future invest in water resources development are a substantial factor in the total federal budget, and in the total national economy.

The federal budget is limited, and water resources development is only one of the claims upon it. How much we can spend for this one purpose, and in what sequence, is a decision which requires the careful weighing of all alternatives. How much need we pay each year for past wars, for national defense, for health, education, postal services and all other federal functions? It is the responsibility of the federal government to seek to allocate all federal funds in such a way as to yield the maximum total benefit for the nation.

Within the budget allocated to water resources development, similar decisions must be made. How can the funds be used in such a way as to achieve maximum benefits? From the point of view of any one region, the policies of the federal government must necessarily often appear "conservative." Many worthy projects will be presented, but not all can be undertaken. It is not enough, from the point of view of the federal government, that a project be good; it must, in order to justify itself, be the best among alternatives. Consideration of each project from the point of view of the total national interest may involve factors which at first sight seem remote from comparison of dollar costs and benefits for any one project.

For example, water resources development in a populous, low-income region might, by giving the people a chance to raise their own income level, lighten pressures on the federal budget for such services as aid to education. The promotion of a greater balance between industry and agriculture in certain regions, or the need for industrial dispersal as part of national defense, might also be relevant in assigning priorities.

The magnitude of the sums involved in federal water resources development makes it necessary, in the interest alike of efficient development and economic stability, for expenditures to follow an orderly, long-range plan. Whatever the merits of public works programs as an aid in minimizing cyclical fluctuations in the field of business, it is undeniable that clearly defined commitments will contribute to stability. A well defined federal investment program, with elements of flexibility, can allow for expansion and contraction in periods of depression and inflation.

A Framework of Principle

In its attempt to reappraise federal water resources policy, the commission has sought to carry forward the tradition which has made our rivers an increasingly important part of the life of the people. As a result, the restatement of the policy which the commission proposes below will be found constructed of building blocks provided by acts of Congress and by administrative decisions of the able people who have directed the nation's great water resources agencies.

This proposed reformulation of water resources policy is constructed on a simple framework of principles. These express:

The importance of clearly defined regional and national goals which water resources programs will be designed to achieve. These objectives will be simply stated in terms of specific contributions which water resources can make to the welfare of the American people.

The necessity of planning for a river basin as a whole instead of having a patchwork of plans by separate agencies for separate purposes. This will assure the most harmonious development of the water resources of the basin, enabling them to make their greatest contribution to the welfare of the people. The motto must be "one river, one plan."

The importance of a simple procedure for determining whether the money to be invested in a river basin program will be well spent. This procedure will take into account more than the obvious benefits which a program confers on the irrigator, the property owner protected against floods, the consumer of low-cost power or the user of water transportation. It will give full weight to the broad economic and social benefits which flow out from water resources projects to increase the prosperity and strength of the region or the nation.

The necessity for a system of repayment designed to treat alike all who enjoy the advantages of federal investment. This will seek reasonable repayment, either through direct charge or assessment, for the opportunity which water resources programs offer for private gain, but will recognize that the great contributions of such programs to the general welfare warrant the assumption by the federal government of the remainder of the cost.

The need for placing the annual financing of water resources undertakings on a river basin program basis and for recognizing the annual renewable resources investment program as a stabilizing factor in the economy. Such resources programs will embody the soundest estimates of what the nation must invest to maintain its basic resources against deterioration and to expand the use of such resources to meet its growing requirements.

The importance of providing those who prepare the plans for the nation's river basin programs with all the knowledge which is required to assure good plans. We cannot afford to have these all-important programs designed in the absence of sufficient information about the resources of water and land, geological formations, conditions of climate or the important economic trends which establish the regional needs that the development must serve.

The necessity for applying sound management principles to our watersheds, to the ground waters which replenish our supplies and to the flood waters which, harnessed, confer a host of blessings. This will mean the use of the waters of our river basins to quench man's thirst, afford him the opportunity for cleanliness, water his deserts, carry his produce, provide the force to generate his hydroelectric energy and the condensation necessary to operate his steam electric plants, make possible his modern industries and provide opportunities for relaxation and leisure.

The importance of utilizing all of these services which water resources offer in such a way as to contribute to the continued building of a strong nation. This will involve the vision of great region-building programs offer-

ing our increasing population broader opportunities for enterprise throughout the land. These opportunities are needed to perpetuate freedom.

The great task of building an expanding national economy of increasing strength through the development and conservation of our water and land resources is one which calls for active cooperation of all the people, in a long-range program in which individuals, local, state and federal governments must jointly participate. In this task, the federal government, as trustee for the whole people, has a crucial and decisive part. It will require at once bold imagination and prudent husbanding of our resources, imagination to see the inspiring possibilities before us, care and foresight to insure that we do not waste our substance and efforts, and so fall short of the realization of the great objectives for which this federal union was created: "To form a more perfect union, establish justice, insure domestic tranquility, provide for the common defense, promote the general welfare, and secure the blessings of liberty for ourselves and our posterity."

Outline of Policy

On these principles the commission has framed a water policy for the American people which is embodied in the following series of recommendations:

Program Planning

1. As a guide to national investment in natural resources development, all federal agencies should be directed to judge new river basin programs in terms of a set of clearly defined national objectives established by Congress.

2. These objectives, as outlined in detail by this commission, should reflect the general purpose of water resources investment to achieve the maximum sustained use of lakes, rivers, and their associated land and ground water resources, to support a continuing high level of prosperity throughout the country. They should include the safeguarding of our resources against deterioration from soil erosion, wasteful forest practices and floods; the improvement and higher utilization of these resources to support an expanding economy and national security; assistance to regional development; expansion of all types of recreational opportunity to meet increasing needs; protection of public health; and opportunity for greater use of transportation and electric power.

3. Congress should direct the responsible federal agencies to submit new proposals for water resources development to Congress only in the form of basin programs which deal with entire basins as units and which take into account all relevant purposes in water and land development. This multiple-purpose basin approach should apply to the whole process by which water resources projects move from the survey to the authorization and appropriation stages. It would enable Congress and the people concerned to have a clear picture of the entire program for each basin and its relation to the economic and social development of the region and the nation.

4. To insure the preparation of sound basin programs, Congress should direct the responsible federal agencies to cooperate with each other and with the appropriate state agencies in the necessary surveys and plans. Such action requires some definite coordina-

tion of the efforts of federal and state agencies. While administrative reorganization in the field of natural resources is outside the assignment of this commission, the commission believes that, lacking such agency reorganization as was recommended by the Commission on Organization of the Executive Branch of the Government (Hoover Commission), Congress should set up a separate river basin commission for each of the major basins. These commissions, set up on a representative basis, should be authorized to coordinate the surveys, construction activities and operations of the federal agencies in the several basins, under the guidance of independent chairmen appointed by the President and with the participation of state agencies in the planning process.

5. Congress should designate the federal departments and independent agencies to participate in the river basin commissions. Such participation should provide for representation of all agencies with functions included in water resources programs. Congress should assure all such agencies adequate authority to participate in comprehensive planning on an equal basis, together with appropriations consistent with such participation.

Evaluation

6. Procedure for evaluation of proposed water resources developments should be revised to apply to multiple-purpose basin programs, and to projects only as constituent parts of such programs.

7. To assure uniformity in the application of evaluation procedure, Congress should direct all federal agencies to apply the same standards and methods to the evaluation of all river basin programs.

8. The orderly formulation of national water resources programs requires the establishment of a federal board of review appointed by the President with the confirmation of the Senate. This board should perform, among others, the functions of the review agencies recommended in the reports of the Hoover Commission.

9. The evaluation procedure should start with the measurement of direct benefits from and costs of programs, but should be supplemented with standard procedure for taking account of secondary costs and benefits. Similarly, values should be assigned to public benefits and costs which affect the general welfare. This could be accomplished in accordance with a standard form of investment appraisal statement for each program or project within that program.

10. The investment appraisal statement should be in a form which would present the benefits and costs simply and clearly for the guidance of Congress and of interested citizen groups.

11. The investment appraisal statement should include a complete estimate of the costs to the American people, both direct and indirect, of undertaking any project. Direct costs should include the initial investment in preliminary investigation, survey and plan; construction; land acquisition; rights-of-way; utility replacement; and administration and overhead. Indirect costs comprise those resulting from displacement of population, loss of land and minerals, loss of wildlife and loss of scenic or historic values. The indirect costs may be stated in non-monetary terms.

12. The investment appraisal statement should also include a complete estimate of primary and secondary benefits. Primary benefits should be

evaluated in terms of a procedure which places a monetary value on those susceptible of such evaluation. Secondary benefits should be estimated by the interested agencies according to a uniform procedure jointly developed with the approval of the board of review. They should reflect the increase in national income resulting from the program.

13. The evaluation procedure should also provide that, where the sum of the benefits so estimated is not sufficient to balance the direct and indirect costs, the final decision by the basin commission on the merits of the project should include a judgment as to whether the balance of general welfare benefits and detriments contributes sufficient additional value to warrant construction of the project.

14. Congress should direct all federal departments and agencies responsible for the development of water and land resources, in cooperation with interested states, to review promptly all existing plans and programs, and to cooperate in preparing coordinated plans for water resources development for the several river basins. Plans already authorized by Congress should remain undisturbed unless this review results in specific recommendations for change.

Basic Data

15. Congress should make ample provision, in the national water resources program, for compilation and analysis of the necessary basic information to assure sound, comprehensive multiple-purpose basin planning. This should include geologic, hydrologic, climatic, land and soil analysis, and economic data to meet the needs of the planning agencies.

16. Congress should require that all basin recommendations carry a precise statement as to the adequacy of the data upon which they are based. Congress should be prepared to withhold approval of recommendations in areas where the data are inadequate.

17. A survey program designed to supply the country with full geological and hydrological knowledge of its surface and ground water resources, including all their characteristics, should be initiated immediately, with ample funds for the early compilation of essential information. Thereafter it should be continued to meet all of the requirements of basin programs.

18. The appropriate agency should be directed to undertake the annual compilation of and report on all water uses and requirements in relation to available sources of supply. This should be comprehensive and should be reported for regions and localities on a basis permitting ten- and twenty-year running forecasts of requirements and supply.

19. A survey should be undertaken promptly to evaluate the possibilities of and provide a program for developing the water now being consumed in the West by unneeded, water-loving plants whose roots tap the water table or the capillary fringe above it.

Financing Programs

20. The financing of the nation's river basin programs should be set up on a long-range basis, with each annual budget request therefor subdivided by river basins. These budget requests, in turn, should be subdivided by projects, functions and agencies. To obtain these results, Congress should direct all federal agencies to submit their budget requests, insofar as they involve water

resources, by river basins. The entire procedure should result in six-year river basin capital investment programs and annual budgets, originating in the agencies, coordinated by the river basin commissions and reviewed by the board of review for submission to the Bureau of the Budget. Congress should make an annual appropriation to each river basin commission for its activities.

21. The annual water resources investment program should be based on a thorough review of the nation's resources and of its resources development requirements. The budget should show the expenditures required to maintain the nation's heritage of land and water resources, to increase the national and regional productivity and to provide for health and recreation.

Reimbursement

22. Congress, in drafting new legislation or amending existing legislation, should provide for a uniform national reimbursement policy and specify the principles to be applied.

23. Reimbursement procedure should aim, as far as possible, to recover a reasonable portion of the benefits accruing from public expenditures for water resources development. This should provide for charges for benefits where they can be collected, and agreements with interested states under which they would utilize their powers of taxation or assessment to assure reimbursement to the federal government for primary and secondary benefits not susceptible of direct collection.

24. Reimbursement policy for given functions such as reclamation by irrigation or drainage should be uniform for all federal agencies.

25. Reimbursement for various types of benefits from water resources programs should be determined in accordance with the following principles: (a) for domestic and industrial water supply and hydroelectric power it should provide for full repayment of water supply or power costs including operation and maintenance, repayment with interest of an appropriate allocation of the program investment, and payment in lieu of local and state taxes which would have been paid on acquired properties; (b) for drainage, irrigation and watershed management it should be based on ability to pay, without interest, measured by the resulting increase in the land operator's net earnings; (c) for navigation it should be determined in connection with a general program for putting charges for all forms of transportation on a cost basis, including interest; (d) for all other benefits, the responsibility for securing repayment of the cost of primary and secondary benefits should be shared by the states on an agreed basis, while general welfare benefits should be the responsibility of the federal government.

26. The federal contribution to the cost of a river basin program or project should be considered as balancing the contributions to the general welfare estimated to result from the undertaking.

27. Congress, in appropriating for basin programs, should distinguish between the portions of the total investment allocable to the different benefits on the basis of proposals by the basin commissions, passed upon by the board of review. Multipurpose program accounts should be established for each basin and for the national water resources program as a whole to assure clear identification of all costs, benefits and repayments.

28. Irrigation projects should be placed on the same basis as other water resources projects for which full reimbursement is not required as a test of feasibility.

Water Resources Management

29. Ground water resources should be included in comprehensive basin programs, with clear recognition of their interrelationship with surface waters, and with due regard to the rights and interests of the state. The federal government should encourage enactment of state laws and negotiation of interstate compacts that foster water management for optimum yield and use, especially with respect to surface and ground water storage opportunities.

30. Watershed management should be included as a principal objective in the planning and development of basin programs, with large enough allotments of funds to enable soil conservation, range management and forest agencies to undertake activities which will bring economically controllable deterioration of the land under control within a reasonable period of time.

31. All related federal policies and activities, including the price support, agricultural conservation, irrigation, credit programs and administration of federal mining laws, should be adjusted to strengthen the effectiveness of watershed management.

32. Flood control should be considered as an important part of water resources management. Conservation storage of flood waters in the soil, underground and in surface reservoirs on tributaries and upper reaches of rivers should be a principal factor in the planning and development of river basin programs.

33. Consistent with other aspects of the basin program, flood storage should be located and designed to assure the greatest possible use and reuse of flood waters in the course of their journey to the sea.

34. Congress should authorize the responsible federal agencies, in reviewing river basin programs, to consider all of the possibilities of flood protection, flood storage and utilization of flood waters. They should consider such measures as local flood protection works, flood plain zoning, flood forecasting, design of levees and related works to release sediment-laden water on the land where this would contribute to fertility of the soil. They should also consider all types and combinations of reservoirs designed to meet the nation's requirements in all fields of water utilization.

Land Reclamation

35. An overall program should be prepared for the employment of all methods for orderly expansion of agricultural production to meet the nation's expanding needs. This program should coordinate irrigation, drainage, flood control, clearing and the sound farm practices which are an essential part of watershed management.

36. The first objective of this program should be adequate provision of farm products from soil so managed that its productivity is enhanced. Irrigation and drainage projects should be authorized only after review, by the Department of Agriculture, indicating that they are in harmony with sound use of land.

37. The weight to be given reclamation of land (including irrigation, drainage, clearing and other measures) in determining the relative priority of programs and order of construction of specific multiple-purpose projects should be based on regional as well as national considerations. National con-

siderations should include federal responsibility for continuing adequacy of dependable farm production, taking cognizance of the time required to bring new lands into the nation's agricultural economy. The expansion of local production to meet the requirements of growing regional economies should also be considered.

38. In determining the desirable schedule for adding to the nation's agricultural acreage through reclamation, full consideration should be given to the probable rate of increase in the productivity of existing agricultural lands through improved agricultural practices, including supplemental irrigation in humid areas. To the extent that such increased productivity is associated with sound land management, it should be recognized as of primary importance. But, beyond this, improved agricultural practices should be left to private business endeavors with the cooperation of the United States Department of Agriculture and the land-grant colleges until such time as the economically sound possibilities of expanding farm acreage through irrigation or drainage have been fully realized. The justification for public investment in irrigation is that there are public ends to be attained which the commercial price system cannot reflect.

39. Decisions as to the relative priority of projects involving various types of reclamation as a means of expanding the country's agricultural acreage should be made in terms of both national and regional economic considerations. They should recognize the extent to which individual projects are integral parts of comprehensive river basin programs serving other important purposes. Important weight should be given to the comparative costs of meeting agricultural production objectives by alternative undertakings, but consideration should also be given to the special usefulness of certain irrigation opportunities in stabilizing agriculture, meeting expanding regional requirements or contributing to regional expansion. The weight to be given these separate considerations should be determined by the board of review upon recommendation of the basin commissions.

40. To protect its interest in securing the maximum reasonable reimbursement from direct beneficiaries of reclamation projects, the federal government should make more effective provision for the adequate planning, sound financing and scientific farming of agricultural development and land settlement on reclamation projects. This should include extension of federal credit at reasonable interest rates for the farmer's investment in structures, equipment, fertilizer, stock and seed, and the technical training and guidance of settlers.

41. Special consideration should be given to rehabilitation of existing irrigation projects, both federal and private, as well as to small new irrigation projects offering the possibility of stabilizing the agriculture of an area.

42. The principle embodied in the reclamation law that the benefits of federal financial assistance through irrigation projects should go only to family-sized farms, together with other antispeculation and antimonopoly provisions, should be maintained and enforced. It should be extended to apply without discrimination to all new projects involving federal investment in the reclaiming of land, whether by irrigation, drainage or other methods.

43. The present 160-acre limitation provision should be considered as a

maximum, with flexibility for adjustment downward after hearings, to adapt it to types of farming characteristic of different areas. It should apply only to the reclaimed portion of a farm.

44. In regions where it is proposed to deliver supplemental water to areas already under irrigation, provision should be made for the supplying of an equitable share of such water to existing farms exceeding the acreage limitation under utility type contracts. In these contracts the charges for the water should be based on the full cost of supplying water to such lands, including amortization with interest of the full investment allocable to this purpose.

45. Before new federal reclamation projects, or projects providing supplemental water or drainage for existing projects, are undertaken, every effort should be made to secure agreements or contracts with the state or states involved or the local interests to be benefited, under which surface and ground water benefits will be considered together. All beneficiaries should be subject to the standard reimbursement obligations, whether securing the benefits from augmented surface or ground waters.

46. The same conditions as to authorization, repayment, technical and financial assistance, and acreage limitation should apply to all projects or project beneficiaries, where federal investment in reclamation of land is concerned. This principle should be applied irrespective of the method of reclamation or the federal agency responsible for the project.

Water Supply

47. Municipal water supply should continue to be primarily a local responsibility, including intercommunity cooperation through the formation of metropolitan water districts to make possible area-wide coordination of water supply sources to meet the needs of an increasing population. The growing needs of communities for water supply should, however, be considered in connection with the planning of all comprehensive basin programs. Their use of water from multiple-purpose reservoirs and improved stream flow should constitute a fully reimbursable service under such programs.

48. Possible future water requirements of large water-using industries should be considered as an important regional and national factor in connection with the planning of comprehensive basin programs. This should be particularly the case in regions where deposits of oil shales or other special resources point to industrial developments of significance to the nation's economic and military security.

49. The possibilities of contributing to municipal and industrial water supply and irrigation through recharging of ground water reservoirs and flows should be given full consideration in connection with all comprehensive basin planning. More complete knowledge of the country's ground water resources may open the way to ground water storage of surplus flood waters as an important supplement to surface storage.

Pollution Control

50. Pollution control should be considered in the planning and development of river basin programs. It should be recognized as a major contribution to the nation's objectives in the fields of water supply, recreation, fish and wildlife.

51. A ten-year period should be set within which to accomplish a reasonable program for cleaning up the nation's polluted waters. Cooperative

efforts of private industries, organizations, municipalities, states and the federal government should be mobilized to that end.

52. Sufficient funds should be appropriated for the administrative and regulatory activities of the Public Health Service, Division of Water Pollution Control to make sure that present congressional policy is adequately tested. Ample funds for federal loans to municipalities should be made available at not more than 2 per cent interest covering the entire cost of constructing the necessary sewage treatment works.

53. Multiple-purpose reservoirs should, as far as consonant with other major purposes, be planned and operated so as not to aggravate, but to contribute to the control of, pollution. This should include regulation of releases of water to make fullest use of the stream's potential self-purification capacity, with advance determination of the schedule of releases to permit proper classification of the stream by the Public Health Service for pollution control purposes.

Waterway Transportation

54. The nation should continue the improvement of its inland and intracoastal waterways to standard depth as an important objective of comprehensive basin programs. This part of water resources development should be integrated into a broader program designed to provide the nation with an economical and efficient coordinated transportation system including railroads, motor transport, waterways and airways. In such a coordinated system all forms of transportation should be considered as complementary rather than competitive with each other.

55. Waterway charges should not be considered as yardsticks for railroad rates, but rather as rates for traffic which, in the coordinated transportation system, can move more economically by water than by rail. In order to assure the greatest overall contribution of the transportation system to the nation's well-being, railroads should not be permitted to establish discriminatory rates paralleling waterway rates.

56. Decisions as to user charges, or tolls, for waterway commerce should be worked out as part of the whole problem of reconciling and making workable a coordinated transportation system. But, with rates for all forms of transportation based on full costs, an interconnected system of modern waterways, coordinated with land transportation, should be able to sustain itself with tolls based on full costs and yield returns on the public investment while contributing to most economic use of the nation's resources.

Hydroelectric Power

57. Full development of the nation's undeveloped water power resources, as an integral part of comprehensive basin programs, should be considered a major federal responsibility, to be exercised in such a way as to assure ample supplies of hydroelectric energy well in advance of expanding regional and national needs.

58. Federal hydroelectric plants should be designed to produce ultimate capacity and energy which will best fit into the requirements of potential markets on the assumption of complete regional integration of power supply.

59. Future licenses for new nonfederal water power developments should be issued only with the joint consent of the federal agencies responsible for power in basin programs. In exercising this responsibility, the federal agencies should continue to recognize the preferential position accorded state and

municipal applicants under the Federal Power Act.

60. The federal power marketing policy heretofore adopted by Congress, authorizing federal agencies to build transmission facilities, giving preferences in power sales to public and cooperative bodies and fostering low rates for residential and rural consumption, should be continued.

61. Federal power marketing policy should be carried out flexibly to assure sound adaptation of federal power supply responsibility to regional power resources and the most effective cooperation of all power systems, public and private, in the task of assuring ample supplies of power at the lowest possible rates.

62. Since private power systems will probably continue to provide a large share of the new capacity required to meet future needs, federal arrangements for marketing power should, where possible, take full advantage of private power facilities, provided the contracts preserve the preferential rights of public bodies and cooperatives to a share of the power, or its equivalent, at the lowest possible rates.

63. Where the federal government assumes a major responsibility for the power supply to distribution systems, this should be recognized as a utility responsibility, requiring the construction of new generating capacity, whether hydroelectric or steam-electric, well in advance of expanding needs.

Fish, Wildlife and Recreation

64. Preservation and enhancement of the nation's fish and wildlife resources should be recognized as one of the important objectives of comprehensive river basin planning. The requirements of this objective should be thoroughly investigated in connection with project proposals designed to serve other major purposes. Releases of water from multiple-purpose reservoir projects should be adequate, except where higher uses dictate otherwise, to guarantee continuous use of the river by wildlife and fish. All proposed basin projects should be studied to determine in advance their effect on waterfowl habitat.

65. The recreation potentialities of all water resources, whether natural or artificial, should be recognized, and expansion of outdoor recreation opportunities should be given full consideration in all comprehensive basin programs. To achieve this objective suitable lands adjacent to federal water projects should be reserved for recreation use, and consideration should be given to minimizing water level fluctuations in storage reservoirs during vacation season, to improving low flows of rivers and to pollution abatement. In densely populated areas and in regions where natural water recreation opportunities are limited, recreation may be a controlling factor in water resources programs.

66. Cooperative arrangements should be worked out with states and local governments for planning, developing and maintaining recreation areas at government water projects, subject to the observance of specified standards, to preserve general opportunity to enjoy the recreation resource under conditions in harmony with the natural environment.

67. Federal participation in recreation features of water resources programs should be determined in relation to federal participation in other recreation programs. To this end, it is desirable that Congress authorize a study of the whole recreation field, hav-

ing as its objective the development of a national recreation policy.

Future Possibilities

68. The federal government should recognize that, with growth of population, urban concentration, industrialization and the need for an expanding agricultural base, availability of fresh water may soon become a limiting factor in the expansion not only of the nation's arid and semiarid regions but also of our entire civilization. The government should, therefore, accept the responsibility for large investment in broad research programs designed to expand the available supplies of water. Such research programs will be directed toward:

(a) Exploring and developing the necessary techniques for utilizing the full possibilities of the nation's ground water resources;

(b) Establishment of a sound national policy for control of artificial rainmaking activities and the application of science to devising methods which can be utilized in the public interest; and

(c) Exploration and experimentation, including pilot plant operation, in the general field of conversion of sea water to fresh water on an economical basis.

In terms of the nation's future, such research and experimentation may well be found to rank with the development of atomic energy utilization.

69. The recommendations summarized above . . . should provide the nucleus of a consistent national water resources policy to guide the nation in the further development and use of its water potentialities.

70. The commission recommends that the policy embodied in the above recommendations be incorporated in a single statute stating both principles and policies, together with provisions requiring their application to all federal water resources activities irrespective of the agency or agencies concerned. Changes arising from these recommendations would, of course, not be applicable to existing contracts with project beneficiaries except upon their agreement. Nor do these recommendations contemplate a departure from the traditional recognition by Congress of rights to the use of water under state law as embodied in such legislation as the Reclamation Act of 1902.

Critical Decisions

The nation is falling far short of reaching the goals set out in the policy outlined above. The design, operation and financing of the present programs of federal, state and local agencies are such that their full potential benefits to the American people will not be realized.

. . . a series of adjustments in federal and state policy . . . will make possible the realization of those benefits. They require major changes in planning, in evaluating projects and in federal and nonfederal financing. To adopt them now would accelerate progress in water resources development. The time never was more propitious for such changes. Nor was it ever more crucial.

This is because the nation is now at a unique stage in water development. For several reasons, it is a stage which will never again recur.

First, the nation is on the threshold of a tremendous increase in the volume of construction for federal water proj-

ects. The cost of projects now under construction or authorized is equal to the entire cost of all federal projects heretofore constructed. And the projects planned but not authorized account for costs at least four times larger.

Second, present mobilization plans impose heavy competing demands for construction materials, machinery and men.

Third, accumulated experience with basin-wide programs in such diverse areas as the Columbia, the Missouri and the Tennessee offers guidance never before available as to the wise planning of river development and as to the basic data essential to reaching sound decisions.

Fourth, technical information on water, land, forest and mineral resources has accumulated rapidly in recent years. Much of this was not available to those who planned the authorized or proposed programs.

Fifth, most basins are relatively undeveloped. Only a few key projects have been built or started. There is still time to make the necessary changes if it is decided that radical alterations are required.

Once they are completed, major water control structures can be altered only with difficulty, or not at all. There are only a relatively few suitable dam sites, and once they are appropriated, the possibilities for economic multiple-purpose development are very limited. Once an irrigation project is developed, it cannot be moved because unfavorable soil or climate factors are discovered. There is a sobering finality in the construction of a river basin development; and it behooves us to be sure we are right before we go ahead.

With these considerations in mind the commission recommends that while readjustments are being made in the whole process of presenting river basin programs to Congress, the following policies apply:

1. Projects now under construction should be completed as rapidly as the national emergency permits.

2. Construction should be initiated on additional projects only as they are clearly shown to be in conformity with revised and approved basin plans, or as they are required to meet the emergency.

3. The review of basin programs and the collection of necessary data should be pushed as rapidly as possible.

4. Among the new projects to be considered for initiation, first priority should be given to safeguarding present and future projects as, for example, by reducing sediment or recharging depleted ground waters, as well as to developing new regional activity, as, for example, by the production and distribution of electric power.

This is a time for action, based on sober consideration of objectives and methods. Continuation of present policies, or lack of them, will mean a continuing waste of money and effort in the pursuit of conflicting goals. If the American people will examine the goals, and the policies under which progress is sought, much of the waste can be avoided, and much larger benefits for the nation as a whole can be achieved.

Authorization for Revenue Bond Issues in California

By Stephen B. Robinson

A paper presented on Oct. 26, 1950, at the California Section Meeting, San Diego, Calif., by Stephen B. Robinson, Atty., Los Angeles.

IN 1947 the author presented a paper on the subject of revenue bond legislation (1) which related to general principles applicable in any state. It was prospective in its approach and was written in the hope that the suggestions made might be useful to those interested in the problem of obtaining revenue bond legislation in their own localities. The present paper will be limited to California law and will touch but lightly on the subject of future legislation.

At the outset it must be noted that the term "revenue bonds" is applied only to bonds issued by public bodies, and that this method of financing is not available to privately owned water works.

A word about the history of revenue bond financing in California may be in order. It is a strange contradiction that while some major projects in California have been financed through revenue bonds with the greatest success, there has not been so general an acceptance of this method here as in some other states. A majority of the California legislature has usually voted against such revenue bond measures as were introduced, and, as will presently be shown, the state supreme court, instead of accepting the so-called "broad special fund theory" adopted in most states, has seen fit to embrace the "limited special fund theory," which tends to restrict the issuance of revenue bonds.

As the advantages of revenue bonds have become more generally realized, however, the pressure on the legislature for the approval of measures permitting their issuance has increased, and it has recently passed several laws authorizing revenue bonds for some limited purposes, fortunately including water works of cities. There is some room for hope that the legislature may gradually allow the use of such bonds for substantially all publicly owned revenue-producing utilities. Moreover, the supreme court has already modified its original position and it seems reasonable to hope that it may fully abandon the "limited" and adopt the "broad" special fund theory.

The present discussion resolves itself naturally into the consideration of two procedures—the issuance of such bonds under general laws and under city charters, respectively.

Procedure Under General Laws

At its 1949 session the California legislature passed an act authorizing the issuance by cities of revenue bonds for water works financing. This was the first general law making it possible for cities to issue revenue bonds for such purposes, although that power could exist under the charters of specific cities and for some years there

had been a general law authorizing irrigation districts to issue revenue bonds.

As some cities lie wholly within the limits of irrigation districts, it is possible that this authority might be used to construct water works within such a city. Such works would be district and not city installations, however, and the situation would occur too rarely to be of general interest.

The 1949 legislation referred to was in the form of a series of amendments to an earlier act, which, while embodied in very few words, was far-reaching in effect. The earlier act was first adopted in 1941 (Cal. Stat. 1941, p. 2582, Deering's General Laws, Act 7560-a) and was officially designated as the "Sanitation and Sewer Revenue Bond Law of 1941." As its name implies, it authorized the issuance of revenue bonds for sanitary and sewerage purposes. Not only cities, but districts of many kinds—in fact, all public corporations or districts authorized to own or operate sanitary or sewer systems—were within its terms.

Early in the 1949 session this act was codified and became a chapter of the Government Code (Sec. 54300–54662), although its previous official designation was retained. The amendments adopted later in the same session changed the title of the chapter to "Sanitation, Sewer and *Water* Revenue Bond Law of 1941," but the power to issue such bonds for water purposes was limited to "incorporated cities." This wording clearly does not include the various districts and public corporations other than cities which are authorized to issue revenue bonds for sanitary and sewer purposes and may even exclude San Francisco, which is a "city and county."

A detailed review of the provisions of this law would serve no useful purpose, but a few of its salient provisions should be noted. Proposals to issue these bonds must be approved by a majority of the voters of the city, unlike general-obligation bonds, which require a two-thirds vote. The bonds must be payable in 40 years at most and may be made callable. The entire authorized issue may be sold at one time or in installments. The bonds are, of course, payable from revenues and not from tax moneys. They are subject to investigation and certification by the California Districts Securities Commission, and, like general-obligation issues, the bonds and the income therefrom are exempt from California (as well as federal) taxation, except for gift, inheritance and estate taxes. The act permits the bringing of an action in superior court to determine the validity of bonds issued under it.

Although a general law is thus provided under which any city in the state may proceed to issue revenue bonds for water works purposes, it would be a mistake to conclude that bond financing under this act is a simple matter and that there are no obstacles to be surmounted. Nevertheless, it would seem that these hindrances are no greater than those which have stood in the way of many other undertakings. Some city, or group of cities, must blaze the trail. When this has been done, the way will be easy for others.

Santa Cruz Case

The first and most serious difficulty arises from the decision of the California supreme court in the case of *Garrett* v. *Swanton* (216 Cal. 220, 13 Pac. 2d 725), in which the "limited special fund theory" was adopted.

The state constitution requires that no city (and no other of several enumerated classes of public bodies) shall

incur any indebtedness exceeding its ordinary annual revenue unless the approval of two-thirds of the voters is obtained and provision is made for a tax to meet the interest and provide a sinking fund for the payment of the principal. It is under this provision that general-obligation bonds must be approved by a two-thirds vote, and the proceedings for their issuance provide for such taxes.

In most states, however, it is generally recognized by the courts that such debt limitations were adopted to prevent excessive taxation, and it is usually held that an indebtedness payable not out of tax moneys but out of a "special fund," like the revenues of a utility, does not fall within the scope of these limitation clauses. This view became known as the "special fund theory," but the courts of a few states, including California, have held that the mere fact that the obligation is not payable out of tax money is not enough to escape the constitutional limitation. As time went on, the original "special fund theory," which was based solely on not using tax moneys, came to be known as the "broad special fund theory," while the description "limited special fund theory" was applied when other criteria were considered in addition. These other elements vary in different states, but any rule which adds to the basic requirement that the obligation be not payable out of tax money falls within the term "limited special fund theory."

The case of *Garrett* v. *Swanton* mentioned above involved the incurring of a debt for the construction of a large pumping plant for the Santa Cruz water system. This debt was payable solely out of water revenues, but the court held that the contract violated the debt limitation clause for three reasons:

1. To come within the special fund theory (said the court), the debt must be payable solely from the revenues of the property to be acquired with the money borrowed (in this instance, from the revenues derived from the new pumping plant alone, without any contribution from revenues of the existing water system).
2. Payments on the debt might deplete the water revenues to the point where they could not meet the obligation (put upon them by ordinance) to pay the principal and interest on outstanding general-obligation water bonds.
3. The financial arrangements provided for a down payment to be made out of the general funds of the city.

The first objection would almost always be applicable when it is desired to issue revenue bonds for making additions to an existing water system, because it is usually impracticable to segregate the revenues in order to determine how much comes from the existing system and how much from the addition. Furthermore, it would usually be difficult, if not impossible, to sell the bonds unless all of the revenues of the works, both existing and proposed, were charged with their payment.

The situation is different when the revenue bonds are to finance the original acquisition of a system by a city which has not previously had its own water works. Here there is no mingling of revenues from existing works with those from newly acquired installations. Nevertheless, if at some future time the city desired to issue bonds to expand the system, this troublesome question would arise.

The second element of the Santa Cruz decision is not quite so troublesome, because it would only apply to

cities with outstanding general-obligation bonds issued for water purposes and with a charter or ordinance provision charging the water revenues with the servicing of those bonds.

The third element in the Santa Cruz case is not a general problem at all, since it would not be presented by revenue bonds, which, necessarily, are payable solely from revenues.

Other Court Decisions

If the court had adhered strictly to the first two criteria in subsequent cases, they would offer a very grave obstacle to the issuance of revenue bonds under the new law—an obstacle which probably would be insurmountable if the bonds were for additions to an existing system, and serious even if they were for the acquisition of a new system.

Fortunately, however, although the court has refused expressly to overrule the Santa Cruz decision, it has gone a long way toward nullifying it by the plainest implication.

The first criterion in the Santa Cruz decision was to all intents and purposes abandoned in the Los Angeles case of *Dept. of Water and Power* v. *Vroman* (218 Cal. 206, 22 Pac. 2d 698), which involved the validity of certain water revenue bonds. Although the relationship to outstanding general-obligation bonds was substantially the same as at Santa Cruz, the court reached the opposite conclusion. It may, therefore, be accepted that the first criterion in the Santa Cruz decision is already practically voided.

The theory behind the second criterion in the Santa Cruz case was considerably modified, if not abandoned, in *California Toll Bridge Authority* v. *Kelly* (218 Cal. 7), involving bonds issued for the San Francisco–Oakland Bay Bridge. In this case, the court held that the fact that only the bridge proper was to be constructed out of the proceeds of the bonds, and that both the original cost of the approaches and the cost of maintenance and operation of the bridge and the approaches were to be paid out of highway funds, did not invalidate the bonds within the principle of the Santa Cruz case.

Although the facts were just sufficiently different so that it cannot be said that this was a flat overruling, even by implication, of the Santa Cruz case, the underlying principle in these cases is nearly the same. It is evident, then, that the court has already gone a long way toward overruling its earlier decision on this question. In other words, the Santa Cruz case is by no means so serious an obstacle as it would appear to be, although definite overruling could only come through a test case. No one could guarantee the result of such a test, but a favorable decision would seem highly probable.

Additional Difficulties

There are also other, but fortunately lesser, difficulties which must be faced. As mentioned previously, the original Sanitation and Sewer Revenue Bond Law of 1941 permitted the issuance of revenue bonds not only by cities, but by numerous types of districts and, in fact, by any public corporation authorized to maintain sewage works. The amendments of 1949 extended the privilege of issuing bonds for water works purposes only to cities, and not to the other classes of public bodies which enjoy the privilege of issuing sanitary and sewer bonds under the act. Some attorneys apparently feel that this runs counter to the "uniform operation" and kindred clauses of the state constitution. Other attorneys feel that it does

not, and the author adheres to the second view.

Then, too, it must be noted that a statute, and particularly as complex a one as an act authorizing the issuance of revenue bonds must be, is something like a battleship which must have a "shakedown cruise" or a large pumping plant which must have a "test run" to see that everything works smoothly.

There are several rough places in the act, and it is probable that the questions which they raise must be settled in a test suit. Most of them spring from the fact that whoever drafted the bill, in a very proper zeal to see that the holders of the bonds had full protection, went a little too far, and some of the provisions of the act dedicate the revenues so completely and fully to the payment of the principal and interest of the bonds as possibly to hamper the ordinary operation of the utility.

Apparently the framers of many revenue bond laws, both in California and elsewhere, have felt that, in order to market the bonds, they must provide that the holders shall have a first—and sometimes an exclusive—claim on the revenues. It would seem that legislators and others concerned with the drafting of such acts have not fully grasped the fact that, as a practical matter, payment of the expenses of the operation and maintenance must, in a sense, come first. Obviously, there will be no revenues out of which to pay bonds if operation and maintenance costs are not met.

The granting of such a claim may be justified in the improbable event of the liquidation of a defunct utility, but a bond purchaser should ordinarily be interested in satisfying himself, first, that he can count on the utility's producing enough revenue to leave a safe margin after paying all costs of operation and maintenance and all costs of servicing the bonds; next, that the rates charged are reasonable and not so near the point of diminishing returns as to preclude raising them if necessary; and, third, that the bondholder has the protection of adequate covenants to maintain rates sufficient to meet all obligations of the fund. As the author sees it, while the utility is a going concern, the holder of a revenue bond is on dangerous ground if he has to think in terms of who gets paid first. His concern should be to make sure there will be money enough to cover all charges.

Procedure Under City Charters

California has probably gone further than any other state in the adoption of the principle of home rule for cities. Cities which have charters, and in those charters have shown their intent to accept the plenary power in municipal affairs granted by the 1914 amendment of Article XI, Section 6 of the state constitution, are wholly independent of any acts of the legislature, provided the subject matter is a "municipal affair" within the meaning of the amendment.

It may be stated unequivocally that establishing and operating a water works is a municipal affair, and that providing funds for doing so through the issuance of bonds, whether general obligation or revenue, is likewise a municipal affair. The city may become invested with the power to issue such bonds under its charter in several ways:

1. The charter may expressly grant that power and prescribe the way in which it shall be exercised. This method leaves it to the legislative body of the city, or to the board which is responsible for the management and

control of the water works, merely to take the steps necessary for the authorization and issuance of any specific bonds.

2. The charter may expressly delegate to the council or other legislative body the power to prescribe the procedures under which such bonds may be issued. The council would then pass an ordinance establishing the procedure, and may leave to itself or to the administrative board, as it sees fit, the responsibility for following it through.

3. If the charter evidences an intention to accept plenary power in municipal affairs, as it usually does, and sets up a legislative body such as a council, as of necessity it must do, then, unless there is something in the charter inconsistent with exercising the right to issue revenue bonds, the legislative body may by ordinance establish bond-issuing procedures even though the power to do so has not been expressly delegated to it.

Method 1

Little comment on Method 1 seems necessary. Los Angeles has set forth in its charter all the procedures to be followed, and its revenue bond financing is recognized in financial circles as being highly successful.

Method 2

It is apparently not as generally realized as it should be that, under the constitutional provisions for home rule charters, cities have power "to make and enforce all laws and regulations in respect to municipal affairs," subject only to restrictions and limitations provided in the charters themselves. If the charter invests the council with the power to prescribe the procedure and the terms and conditions under which bonds may be offered, the council, in carrying out this power, notwithstanding the fact that what it passes may be called an ordinance, is enacting a law, which, within the city, excludes the operation of the laws passed by the state legislature on the same subject and is of equal dignity.

Method 3

A 1914 amendment to the California constitution provides that cities may have every possible power in municipal affairs which is not denied by their several charters. Therefore, in determining whether or not a city has a particular power, one must first establish whether or not the subject matter is a municipal affair. If it is, it is then necessary to see whether the charter was adopted since the 1914 amendment; if adopted prior to that time, it must have been so amended as to show an intent to accept the offer of plenary powers embodied in the 1914 amendment. Finally, it must be ascertained that the charter does not deny to the city the power in question. When these conditions are met, the power exists regardless of whether or not it is expressly mentioned in the charter.

It should be realized, however, that a charter may deny the power to issue revenue bonds not only by an express prohibition but also indirectly and sometimes obscurely. The author has had occasion to examine a number of charters with this question in mind and has yet to find one which denies the right explicitly. But there are many which say that the general laws of the state shall be followed in the issuance of all bonds, which would preclude their issuance under charter procedure but not under the recent act. Apparently the framers of many charters had the feeling that, because they had not affirmatively included a procedure for the issuance of bonds (whether general obligation or revenue), they

must "round out" their work by saying that the procedure must be under state law.

Provisions of the indirect or obscure kind which whittle down the plenary power so that it becomes insufficient may be illustrated by the following examples. One charter had a provision that all the receipts from its water department in excess of the payment of the cost of operating and maintaining the works should be paid over into the general fund of the city. This seems to forbid applying such revenues to the payment of bonds. Possibly there are charters which require that all revenues shall be paid into some fund which also receives money from tax sources. Such mingling of revenues and tax money might complicate, if not defeat, the issuance of revenue bonds. If a charter gives the city manager control of all municipal property, this would exclude the council from vesting control in a separate board. The significance of the latter point is made apparent in connection with the "separate entity theory" discussed below.

It is evident that a city which lacks adequate power to issue revenue bonds can remedy the situation by an appropriate charter amendment. This can be done without the difficulty which sometimes attends an effort to get the state legislature to pass a general law on the subject of revenue bonds, for it is the custom of the legislature to approve all charter amendments adopted by a sufficient vote of the people, and such approval is obtained without the clashes of opinion which often attend the passage of general laws.

It should be noted that, regardless of which of the three methods discussed may be applicable, the provisions for the issuance of revenue bonds set up in a charter or under its authority may cover the whole field and completely displace general laws on the subject. To illustrate, the procedure established by or under a charter does not have to conform to the requirement of the Sanitation, Sewer and Water Revenue Bond Law of 1941 that the proposition on issuing the bonds must be submitted to the voters and carried by a majority vote.

Separate Entity Theory

The so-called "separate entity theory" also has a bearing upon the problem of the issuance of revenue bonds for water works purposes, whether such issuance is to be under the Sanitation, Sewer and Water Revenue Bond Law of 1941 or under a city charter.

To explain this theory, it must be pointed out that the courts have uniformly held that provisions of the state constitution are to be enforced exactly as written. Numerous constitutional provisions put various restrictions upon public bodies. For example, one may say that no city shall do so and so; another may say that no city, county or school district shall do so and so; still another may name seven or eight classes of public corporations which are restrained from taking certain specific actions.

The debt limitation provision previously referred to states that "no county, city, town, township, board of education, or school district" shall incur indebtedness in excess of the annual revenues without a two-thirds vote and provision for a tax. The courts have held that this debt limitation has no application to irrigation districts, for example, or to any of literally dozens of districts other than school districts which may exist under California law. In fact, the courts have gone a step further and repeatedly held that the Los An-

geles Dept. of Water and Power is an entity distinct from the city to such an extent that its obligations payable out of the water or power revenues do not constitute an indebtedness of the city. Therefore, the revenue bonds of that department are not within this debt limitation provision.

At first blush, it may seem unreasonable for the courts to differentiate between a city and one of its departments. But the state constitution itself, in effect, drew the distinction between a city and its board of education by using the language "no . . . city, . . . board of education or . . . ," for a board of education is always a department of a city.

It follows that, if a city sees fit to set up a department authorized to manage and control the water works (whether or not coupled with the management and control of other utilities); if that department is managed by a board which is substantially free from the control of the general legislative body of the city; and if the department has certain other characteristics of separateness commented upon by the courts, it may issue revenue bonds which are not considered city indebtedness and therefore escape the operation of the debt limitation clause of the constitution.

Inasmuch as the stumbling block presented by the *Garrett* v. *Swanton* decision rests solely upon this debt limitation provision, it may be completely overcome by setting up such a separate department. The latter would be free to proceed under the Sanitation, Sewer and Water Revenue Bond Law of 1941, or the bonds could be issued under the charter pursuant to any of the three methods set forth above, without any restraint springing from the *Garrett* v. *Swanton* decision.

Moreover, in a manner analogous to that discussed under the second and third methods of providing for the issuance of revenue bonds, such an independent department could be created by ordinance if the charter, either expressly or by the absence of inconsistent provisions, empowers such action of the council.

Conclusion

From the foregoing, it is apparent that: [1] every California city now has the power to issue revenue bonds under the Sanitation, Sewer and Water Revenue Bond Law of 1941, except in the improbable event that its charter, expressly or by necessary implication, precludes it from so doing; [2] the existing charter of any city may possibly be found, on examination, to be adequate to support the issuance of such bonds; and [3] any city, by adopting a charter or amending an existing one, may issue such bonds by procedures established by or under such charter.

Under each of these conditions, test litigation would be necessary to overcome the *Garrett* v. *Swanton* decision, unless provision is made by charter for the creation of a separate department and such bonds are issued by it.

In some circumstances, test cases might be necessary to clarify provisions of the Sanitation, Sewer and Water Revenue Bond Law of 1941, or of existing charter provisions, but the burden of such litigation should not be more onerous than is usual in the undertaking of public projects.

Reference

1. ROBINSON, STEPHEN B. Legislation for Revenue Bond Financing. Jour. A.W. W.A., **39**:1021 (Oct. 1947).

The Customer's Interest in Utility Economics

By Richard L. Rosenthal

A paper presented on Sept. 7, 1950, at the New York Section Meeting, Upper Saranac Lake, N.Y., by Richard L. Rosenthal, Pres., New York Water Service Corp., New York.

THOSE engaged in the utility business have not realized as completely as they might the fact that customers of privately managed and privately owned utility companies are just as much interested in the details of a utility's economic life as are the stockholders. If a company is confident that it is providing service with maximum efficiency and at minimum cost, considering all factors, it should want its customers to know the fundamental reasons for its costs and, therefore, for the rates it must charge.

Although most customers are not aware of it, the utility company has a "cost-of-living" problem itself. The private utility company, fundamentally, is merely a vehicle which permits the achievement or performance of three basic social and economic functions. The first of these is to provide adequate service at the minimum rates consistent with economy of operation. The second is to pay the operating costs involved in providing adequate service, present and future. These costs, of course, include proper and reasonable wages and salaries, property and income taxes, fuel and other purchased material and supplies, and the wearing out or depreciation of plant and equipment. The third utility company function is to produce sufficient net income —after all operating costs, including taxes, are paid—to persuade investors to furnish the continuous supply of new capital needed for plant and equipment replacement and expansion.

It is the combination of the cost of the second and third functions which constitutes the "cost of living" for the utility. Unless a utility company can produce the investor-dictated quota of net income—net income adequate continually to attract capital as measured by the markets for the utility's securities—it cannot obtain capital and, therefore, cannot maintain, improve and expand its facilities. Thus, if the utility company's earnings are not sufficient, the public interest suffers accordingly, in terms of adequate service to consumers. The utility company must compete in the capital markets with all other enterprises—with industrial, railroad and other utility companies—and with federal, state and municipal government, for the investors' dollars. Like all of its competitors, including government, it must pay the investors' price—it must earn what investors require as return, as indicated by market prices for securities.

As a matter of fact, a properly regulated utility company does not, itself, really make a "profit" in the technical sense of the term. It earns a net income, but, if the utility is properly regulated, that net income is only so much as is required to "hire" the investors' funds.

Every effort must be made to encourage customers to comprehend that

the utility must have rates sufficient—but only sufficient—to perform these three basic functions. In order to stay in business, a utility company must deal fairly with its customers, or they will not use its services. It must deal fairly with its employees, or it will not have the staff with which to operate efficiently. Most people will quickly agree with these two premises.

It is just as important—and just as fundamental—that the utility company deal fairly with its investors. If it does not, or cannot because it is not permitted to charge enough to earn the rate of return which investors require, the utility company will not be able to continue to expand and improve its service by additions to plant and facilities.

Service to customers may be likened to a cart; capital is the horse which pulls the cart; and return on investment is feed for the horse. If the horse does not eat, he will not—and ultimately cannot—pull the cart. If the customer understands this, the rate and revenue requirements of the private utility will be readily appreciated. In time they should be understood by the customer as being basically in his interest, the interest of more and better service to more consumers.

If a utility earns a satisfactory net income, it can attract capital in competition with other capital-seeking enterprises and governmental units. If it attracts capital, it can perform its first function: to provide adequate service. If it does not attract capital, it cannot. Fundamentally, the problem is as simple as that. Those in the industry know it, but they must be sure that their customers understand and appreciate it, too.

Utility companies everywhere have in the past few years experienced an unusually sharp rise in local taxes, adding substantially to expenses. Projected increases in federal taxes will also increase expenses considerably and thereby reduce net income.

Utility officials and managers all want to provide more and better service to more customers. But the multibillion-dollar aggregates of capital required in order to achieve this end make it necessary to raise funds from the investing public. This is not a theory; it is a continuing condition. It needs to be reiterated that whatever the personal desires of the individual company officials relative to continuing a construction and expansion program, the earnings of a company and the personal funds of its officials are not sufficient to finance the program under present expansion requirements. Therefore, such a program cannot be continued unless investors can be persuaded by a company's earnings to furnish additional funds to the company. Without such funds in large amounts, equipment necessary to the program cannot be purchased. The manufacturers of such equipment want to be paid for it in cash, not in good intentions.

If increased costs, and particularly increased local and federal taxes, reduce the net income of the utility company so that it cannot raise funds from the investing public, the company's predicament can be solved only in one of two ways. The first of these would be entirely to eliminate future capital investment and, therefore, the addition and replacement of facilities and equipment. This, of course, would adversely affect consumers, because it would not enable the utility company to provide new customers with service and would restrict the company from providing present users with improved

service in greater quantities. The other alternative is to seek relief through higher rates, in order that the utility's income may be restored to a level adequate to obtain investor capital. This, of course, affects the customer directly.

The customer, therefore, has just as obvious an interest in what is happening to the operating cost of a utility company as do that company's management and its investors. Higher local taxes, higher federal income taxes and higher operating costs of all types are ultimately things for which the customer pays, if he desires continued improvement in service and the availability of greater quantities of such service to more consumers. By reason of the industry's enormous capital requirements and investor-dictated rate of return, as indicated by markets for its securities, the utility company can operate in no other way.

The utility company is not a bottomless well into which local and federal government can dip to obtain ever increasing amounts of taxes, or which suppliers can tap for increased prices for their products and employees can drain for higher wages and salaries. As these demands upon its funds increase, rates must also be increased or services curtailed. Customer knowledge of these facts of economic life will perhaps aid the utility company in holding down its costs. In any event, such knowledge will indicate to the customers why the utility company must—no matter what the personal desires of its officials—seek rate increases when costs and taxes go up substantially.

Determining Future Water Requirements

By Clayburn C. Elder

A paper presented on Oct. 27, 1950, at the California Section Meeting, San Diego, Calif., by Clayburn C. Elder, Hydrographic Engr., Metropolitan Water Dist. of Southern California, Los Angeles.

THE water needs of cities and suburban areas continue to be of immediate concern to engineers, designers, operators, budget and finance officials, and, above all, to water users and hard-pressed taxpayers. The headline news value of water shortages has been recently emphasized by the now happily ended New York regional drought and the much more widespread, serious lack of rain that still prevails in the Southwest after six years. Studies and reviews of future water requirements are, therefore, worthy of prompt attention, although unpredictable variables will still rise like goblins to haunt well intentioned planners of water supply projects.

It should be stressed that the word "future" does not really imply any crystal-ball gazing or magic-telescope peering into the fourth dimension of the time-space continuum. Rather, in conservative engineering fashion, it is necessary to "drive the water truck" with at least one eye attending closely to the disclosures of the rear-view mirror, as must all modern drivers or planners who wish to survive long enough to experience as well as guess about the future.

Records of Water Use

These rear-view mirror realities are, in the present context, represented by recent water use records. Such statistics are rather tricky, however, unless interpreted on the basis of first-hand familiarity, because water service areas, though always more or less coincident, are never identical with the city's legal boundaries. Moreover, census reports cover only permanent residents; they do not include the semipermanent six-month visitors; the transient tourists, business men and convention addicts; the many commuters with homes in the suburbs; and, finally, the week-end mob of guests at resort and beach towns. All these are substantial users of water.

For these reasons, but principally because the data are easily available and have not been previously compiled in the present form and analyzed statistically, chief emphasis is given (Table 1) to the water *production* records, since 1928, of the member cities and areas forming the Metropolitan Water Dist. of Southern California, as constituted on July 1, 1950. This date is used in order to eliminate at least one variable, the district's expanding area, which has increased substantially both before and since (*see* Table 2). The previously published data have therefore been supplemented and adjusted slightly as needed to conform to the July 1, 1950, area of 910 square miles.

The water use data of Table 1 are in terms of water production rather than the more familiar net water consumption or metered retail sales of water. Production figures include the distribution system losses (plus unaccounted-for water and measurement errors) av-

TABLE 1

Metropolitan Water District Production and Use

Year	Water Production*			Population Served *1,000's*	Domestic & Indus. Water Use		Business Activity Index‡ (1939–40 = 100)	Seasonal Rainfall Index (75-yr. Normal = 100)
	Total *mgd.*	Domestic & Indus. Only						
		mgd.	Index (1950 = 100)		*gpcd.*†	Index (1939–40 = 100)		
1928–29	323.5	250.1	48.4	1,850	135	110	130	69
1929–30	343.2	260.8	50.5	1,900	137	111	120	78
1930–31	335.1	254.8	49.3	1,930	132	107	100	92
1931–32	315.6	242.8	47.0	1,960	124	101	77	122
1932–33	294.3	232.4	45.0	1,980	117	95	63	73
1933–34	293.8	227.3	44.0	2,000	114	93	68	68
1934–35	227.8	220.2	42.6	2,000	110	90	77	131
1935–36	323.1	246.7	47.8	2,100	117	95	90	68
1936–37	328.4	257.7	49.9	2,150	120	98	100	141
1937–38	340.3	272.3	52.7	2,225	122	99	93	147
1938–39	351.7	283.5	54.9	2,300	123	100	95	118
1939–40	348.0	291.2	56.4	2,375	123	100	100	81
1940–41	355.0	300.1	58.1	2,450	123	100	113	215
1941–42	386.8	321.1	62.2	2,550	126	102	131	80
1942–43	430.5	358.9	69.5	2,650	135	110	153	148
1943–44	474.8	399.7	77.4	2,750	145	118	175	158
1944–45	499.0	427.0	82.7	2,875	149	121	170	90
1945–46	544.6	461.1	89.3	3,000	154	125	165	88
1946–47	549.9	465.7	90.2	3,050	153	124	180	92
1947–48	578.6	493.4	95.5	3,150	157	128	191	51
1948–49	588.4	503.1	97.4	3,250	155	126	183	57
1949–50	594.2	516.4	100.0	3,350	154	125	185	66

* Including Colorado River Aqueduct deliveries since June 1941.
† Gallons per capita per day. Twenty-two year mean: 133.0.
‡ Adjusted for population trend.

eraging 5–10 per cent. For most of the cities involved, the record comprises their total well pumpage plus purchases of Colorado River Aqueduct water as delivered at the head of their distribution systems. Included also are diversions of springs, stream flow, mountain reservoir releases and deliveries of the Owens River Aqueduct to Los Angeles. But losses from Los Angeles Aqueduct reservoirs and San Diego mountain reservoirs are not included. Water production records are used and preferred by the district because they are much more significant and indicative of needs for supplemental Colorado River water at its delivery points.

The actual population served can only be approximated, with temporary residents and tourists averaging about 100,000 annually, increasing to possibly 200,000 during major American Legion, Shrine or other conventions. Approximately 4 or 5 per cent of the Los Angeles census population is not served as yet by the city water department; in contrast, Pasadena supplies water to about 23,000 persons outside its boundaries and Beverly Hills to about 3,000 in outside areas, while several other member cities have

TABLE 2

Metropolitan Water District

Item	Five Coastal Plain Counties*	Four Coastal Plain Counties†
July 1, 1950:		
Population	3,350,000	2,915,000
Per cent of total	64.5	62.5
Per cent of city totals	82.0	80.0
Gross area—*sq. mi.*	910	728
Per cent of total	36.0	33.0
Nov. 1, 1950:‡		
Population (1950 census)	3,420,000	2,975,000
Per cent of total	66.0	64.0
Gross area—*sq. mi.*	1,004	820
Per cent of total	40.0	37.0
Including initiated annexation:§		
Population (1950 census)	3,600,000	3,150,000
Per cent of total	69.0	68.0
Gross area—*sq. mi.*	1,475	1,290
Per cent of total	59.0	59.0
Entire coastal plain:		
Population	5,200,000	4,675,000
Habitable area—*sq. mi.*	2,500	2,200

* San Diego, Orange, Los Angeles, Riverside and San Bernardino Counties.
† Excluding San Diego County.
‡ Including Escondido and Pomona Valley districts.
§ Including Chino Basin, Hemet–Perris–San Jacinto Basin and Lower Santa Ana Basin.

similar responsibilities. For the entire Metropolitan Water Dist., the actual net population supplied with water is estimated as slightly greater than the census count but for present purposes is taken as equal to it. For individual cities, this approximation might be considerably in error if used in computing per capita consumption.

Water for incidental irrigation of gardens and lawn sprinkling is included in the water use records as no basis is usually available for estimating and excluding such use. In any event, these uses will occur in new subdivisions or new construction in the older sections of the cities and must be anticipated to continue indefinitely into the future in about the same proportion of the total water use as at present. Intermittent commercial irrigation, as in the San Fernando section of Los Angeles and in some areas near San Diego, being separately measured, is listed separately and excluded in computing per capita water use.

Per Capita Water Use

The water production records in Table 1 refer to municipal systems (and the chief companies serving urban areas), but include also the well pumpage of the major industrial plants in the West Basin Dist., estimated at 15,000 acre-ft.* About twice this amount is produced by private pumping in the Los Angeles area, according to surveys of previous years, and approximately 5,000 acre-ft. per year (4.5 mgd.) within the limits of other Metropolitan Water Dist. cities of Los Angeles County. This additional total of 50,000 acre-ft. per year (44.6 mgd.) chiefly for industrial use, is 7.5 per cent of the reported total for 1950 (594 mgd. or 665,500 acre-ft.). Substantial volumes of water from nonmunicipal sources are used for irrigation in several Orange County cities, but records for these uses are not immediately available and are not essential to the present study.

Water production for domestic and industrial uses only varied from 250 mgd. in 1928–29 to 220 in 1934–35 and gradually increased to 516 in 1949–50. Much of this rise in water use and production is, of course, a re-

* Or 13.4 mgd. An acre-foot contains 325,872.36 gal.

sult of the population increase of 81 per cent witihin the 22-year period since the district was organized. The per capita water production figures varied from 135 gpcd. (gallons per capita per day) in 1928–29 to a minimum of 110 in 1934–35, the 1949–50 figure being 154. Because the range of variation is relatively great, consideration of its probable causes is worth while.

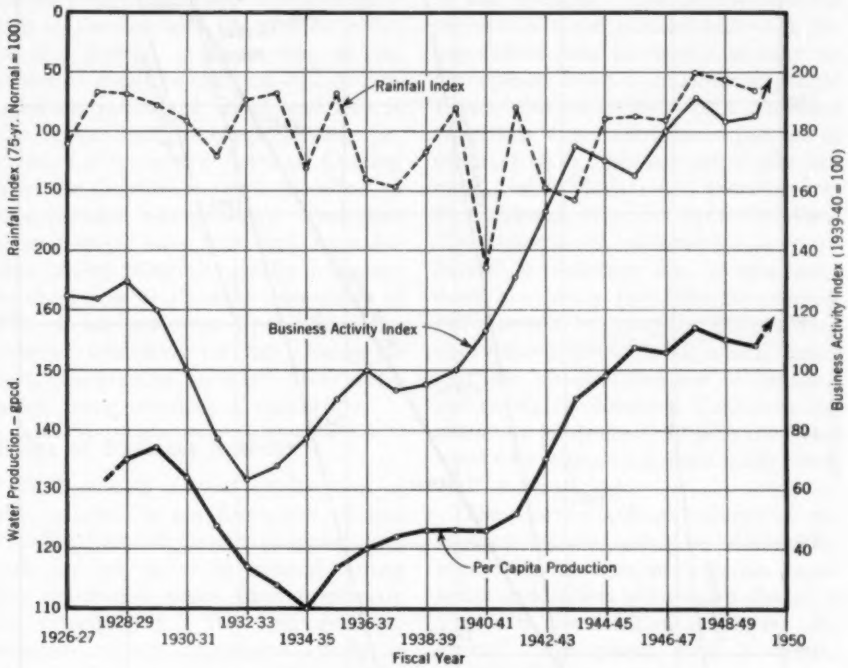

Fig. 1. Factors in Water Use

Above are plotted the data on per capita production of water for domestic and industrial use, adjusted business activity index and rainfall index given in Table 1. Although the rainfall curve seems to bear little relationship to the production curve, there is a striking similarity between the latter and the business activity curve.

It was anticipated that physical factors such as rainfall and air temperature would account for a substantial part of the observed variation in per capita use. During abnormally hot periods of a few days' duration and also when spring or autumn rains are deficient, water sales increase markedly because of lawn sprinkling, garden irrigation and other demands. On an annual basis, however, the effect of such hot spells is compensated for and becomes negligible. Likewise, the rainfall factor appears to be of only slight importance. The regional precipitation index curve shows no evident pattern of relationship with the per capita use curve in Fig. 1. The coefficient of correlation is -0.32 ± 0.14 for the 22-year period under discussion, indicating possibly a slight inverse relationship, but the degree of correlation is too low to be significant.

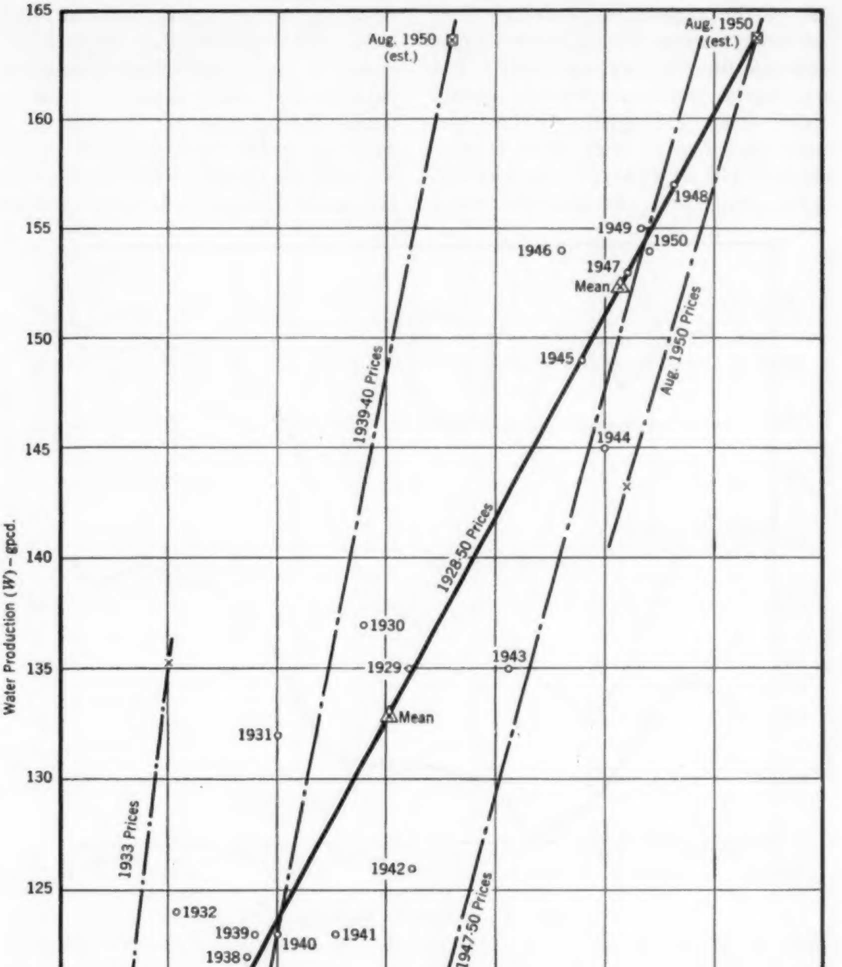

Fig. 2. Effect of Price Changes

The scatter diagram above indicates a straight-line relationship between per capita domestic and industrial production (W) *and the business activity index* (I). *Based on average prices for the period 1928–50, this relationship can be expressed by the linear equation:* $W = 0.365I + 87$. *For 1939–40 prices, the equation is:* $W = 1.02I + 21.4$; *and for 1947–50 prices,* $W = 0.72I + 21.4$.

Another factor generally assumed to have a definite inverse effect on per capita water production and use is an increase in retail water rates. During the 22-year period numerous small rate increases have been made in district member cities, which cumulatively over the entire period range from 5 to 25 per cent. The major rate change—that is, the one with the greatest effect on the district average—was an increase of about 18 per cent in Los Angeles on January 1, 1938, and this is the approximate average 22-year increase for the entire district. Coming after the depression years, the effect of this variable was probably much less than it might have been had not inflation caused relatively greater increases in the prices of all other necessities of life. It has not seemed possible to determine separately the rate change effect, obscured by so many other variables, using the data of this study.

Index of Business Activity

Still seeking a valid explanation of the variation in per capita use, it was recalled that the district produced and sold far less water in general during the depression years than previously or subsequently. The best available measure of the depression effects is the "Index of Business Activity in Southern California" (adjusted for increasing population) compiled by the research department of the Security-First National Bank of Los Angeles.

This index is a weighted average of ten seasonally adjusted business series. With their respective percentage weights, these are as follows: department store sales, 15; building permits, 5; Los Angeles bank debits, 20; residential city bank debits, 5; agricultural city bank debits, 5; industrial employment, 20; industrial power sales, 13; railroad freight volume, 6; telephones in use, 7; and real estate sales activity, 4. The index is expressed as a percentage of 1939–40 business activity, the most recent years in which business was neither depressed nor unusually active. It will be noted that volume or value of water sales does not enter into the derivation of the index in any manner. The adjustment for population trend is consistent with the population data as nearly as may be determined from a small-scale graph. Five of the ten series, with a combined weight of 50 per cent, are expressed in physical units, but the other five are expressed in dollars and therefore reflect changes in prices over the years. The index is not adjusted for price inflation or deflation but, if this were done, the index (of 210) for August 1950 would be roughly 40 per cent above the 1939–40 level, which means that the physical volume of business per capita in Southern California has risen to a point about 40 per cent above what was regarded as reasonably "normal" a decade ago.

The corresponding values of the business activity index, as adjusted for population changes, and the per capita water production volume are plotted in Fig. 2 in the form of a "scatter diagram." The points show a definite straight-line relationship, expressed by the equation $W=0.365I+87$, in which W is the regional water production in gallons per capita per day and I is the business activity index. The coefficient of correlation is very high: $r=+0.94\pm0.02$. (A coefficient $r=+1.0$ would indicate perfect direct correlation and 0.0 would show no correlation, while negative values to -1.0 would mean inverse correlation.) As the curves of Fig. 1 indicate, there is also a close correlation between values of W for any given year and those of I for the two preceding years, or, other-

wise stated, there may be a lag of one to two years in the effect of I on W. A simpler interpretation may be that there is a close correlation between each year's I and the values of the index for the preceding year or two, the latter thus also affecting W, though indirectly and with a lag of one or two years.

This W–I curve has such a close correlation (a far higher coefficient than was anticipated or seemed possible) that the business activity represented by the index is evidently the dominant significant factor affecting the regional per capita water use. The equation $W=0.365I+87$ shows that, on the average and with price inflation changes as of the last decade, a three-point increase in the index means an increase of about 1 gpcd. in water requirements. It also indicates that with zero business activity, if that can be conceived of (the minimum annual average for the extreme depression period was 63), the per capita water requirement might be about 87 gpcd. By comparison, a survey in Los Angeles for 1930 showed that the average domestic use of water by residential and small commercial connections was 89 gpcd., allowing for a recorded 5 per cent loss in the distribution system.

A somewhat comparable minimum residential use figure, eliminating all effects of industrial activity, is given by Walasyk (1). He reports that a study of 35 apartment buildings of various sizes in northern New Jersey showed an average net consumption of 59 gpcd. Allowing for the normal proportion of single-family dwellings, with their yard and garden water use, and also for distribution system losses, the minimum use in the W–I equation for the New Jersey–New York region might be 70–75 gpcd., compared with the 87 gpcd. for Southern California.

Inflation and Deflation Effects

The business activity index is not adjusted for price changes, but it can be presumed that any major change in the index or regional volume of business extending over a period of years would involve corresponding price changes in the value of the dollar. The W–I values of subsequent years would probably move up and down the historical base W–I curve of Fig. 2. For short-term changes in I involving relatively little added inflation or depression-deflation factors, the variation in W would theoretically be along the supplemental lines or similar related ones, as indicated.

Assuming the August 1950 index value of 210 to plot on the base curve at $W=163.65$, then a corresponding point on the W–I line for 1939–40 price conditions is $I=140$ and $W=163.65$. The line passing through this point and that with the historical values for 1939–40 ($I=100$ and $W=123$) has an equation of $W=1.02I+21$. Extreme depression conditions, as in 1932–34, indicate a similar curve further to the left. For 1947–50 price conditions, with a mean of $W=155$ for $I=185$, the short-term equation becomes $W=0.72I+21$. For August 1950 when much of the Korean War inflation had occurred, the momentary or fixed-dollar curve is still farther to the right. These short-term W–I lines merely serve to generalize the conception of the W–I relationship and explain the observed scattering of some of the annual values, but may also aid in avoiding misuse of the base historical line.

Range in Per Capita Use

The previous discussion of water production and use dealt with annual averages over the major portion of the Southern California region as included

in the Metropolitan Water Dist. Within this large area extending from the harbor and beach cities to high in the foothills of the Sierra Madre above 2,000-ft. elevation, there is naturally a wide range of climatic conditions and types of water use. For the year 1949–50 and the depression period minimum year, 1934–35, water production averages in the three typical zones of Los Angeles County, plus Santa Ana City in Orange County and the San Diego County Water Authority, are tabulated with illustrative weather records added to complete the zonal comparison (Table 3).

TABLE 3

Range in Per Capita Use

Zone	Avg. Domestic & Indus. Production *gpcd.*		Rainfall—*in.*			Temp.—°F.		Weather Station
	1949–50	1934–35	1947	1949–50	Normal	Mean Summer Max.	Mean Winter Min.	
Los Angeles County								
Foothill	193	140	5.3	14.6	20.1	87	40	Pasadena
Central	150	117	4.1	10.6	15.2	81	46	Los Angeles Civic Center
Coastal	123	100	3.6	10.0	11.3	79	48	Los Angeles Harbor
Orange County	137	104	5.6	9.1	14.4	84	41	Santa Ana
San Diego County	140	110	6.3	8.6	10.3	73	48	San Diego
Weighted avg.	154	110	4.0	10.0	15.0	81	45	

The relatively higher use of water in the foothill zone, as shown in Table 3, is in part a result of the uniformly higher summer temperatures, but an equally important factor is the higher proportion of single-family homes and large estates, maintaining larger areas of lawns and gardens per capita. The increased rainfall, as compared with the lower zones, comes, of course, only in the winter and spring months and therefore does not fully offset the greater need for lawn and garden sprinkling.

Although annual means are essential in studies of water supply, they tell only a part of the water story. As an extreme example, under Southwest desert conditions, the mechanized divisions which trained along the Colorado River Aqueduct in the early years of World War II were allowed only 1 gpcd. on five-day maneuvers. In camp, the men used about 8 gpcd. for all purposes during the toughening process.

An average-sized man leading a sedentary city life has a normal loss of water of about 6 pints per day but two-thirds of this is recovered in his average mixed diet. This leaves only about 2 pints or four glasses per day to be drunk as water (carbonated or otherwise mixed, as preferred). Under more active conditions in summer, a real thirst may increase this minimum to a gallon of water or more, but 0.5 gpd., or about one ton a year, is close to the annual average. In the course of a full lifetime, this average adult will drink nearly 20,000 gal. of water, or at least 1,000 times his own body weight. Incidentally, if he can arrange for a large enough (self-sterilizing) storage tank of his own, in order to

buy a lifetime supply within a one-month period, and if he lives in Los Angeles or almost any other Southern California city, the total cost will be less than $4.00, or, say, 5¢ a year for drinks, a real bargain if there ever was one. If drawn from the faucet as required, in more normal fashion, the cost would be $1,000, which seems to prove the value and importance of adequate local storage.

In direct proportion to the completeness and convenience of plumbing facilities, per capita domestic water uses rise from an 8- or 10-gpd. minimum needed even when the water must be carried some distance from a spring or well. Foreign cities show a 30–50-gpcd. use, including even the large European capitals. As average American plumbing standards are approached, the use equals 80–90 gpcd., a figure which applies to some residential suburbs and is indicated by the business activity index equation mentioned previously. But these values are frequently double or more where industrial water uses have become important or under such conditions as exist in the Los Angeles foothill zone. Above these fairly normal rates of water use, the sky still seems to be the limit for special locations or unusual circumstances.

Perhaps the best example of such a maximum is found in the unique suburban industrial city of Vernon, adjacent to Los Angeles on the southeast. It can claim uniqueness for many reasons, such as a 1950 population of less than half of that counted in 1940 (417 in 1950, 850 in 1940), although the water use from its municipal water system more than doubled during this same decade, increasing from 993 to 2,133 mil.gal. per year. City water connections number 645, which is 50 per cent greater than the 1950 census count of residents, who must be credited with an average annual water use of 14,000 gpcd. This sort of record is enough to drive water system designers and planners crazy.

Fontana Steel Plant Use

Before entirely abandoning attempts to plan and forecast water needs of the future, another unusual and indeed outstanding example of industrial use must be mentioned. This is the Kaiser Steel Corp. Fontana plant in West San Bernardino County, 45 miles east of Los Angeles, with a current annual output of 1,200,000 ingot tons and a plant investment of $160,000,000. Most such plants are located on rivers or lakes which serve both as a source and a means of disposal of the large volumes of water involved. A recent national survey of the steel industry showed an average water use of 65,000 gal. per ton of output. In terms of the Fontana plant production, this would amount to 215 mgd., or 240,000 acre-ft. annually. Allowing for planned expansion of the plant, its water requirement would, on this normal basis, be equivalent to the capacity flow of the Owens Valley Aqueduct to Los Angeles. Of course, there is no such volume of water available for one industry either near Fontana or anywhere else in Southern California.

By the addition of carefully designed modern facilities and very efficient use of water, the Fontana plant's gross use of water has been reduced to about 44,000 gal. per ton of steel, the national average being 50 per cent greater. Then, by a complete reclamation process representing an added investment of about $3,000,000, with no water leaving the plant area except by evaporation during cooling, the makeup water requirement is reduced to 2.5 per cent of the total gross use. This means that, on the average, the water

is reclaimed and reused 40 times in its course through the plant. The requirement for makeup water for steel production, domestic consumption and some irrigation (lawns and gardens) is now about 1,100 gal. per ton of finished product.

This figure still amounts to 3.6 mgd., or 900 gpcd. in terms of the number of workmen employed. On the plant area of 1,400 acres, however, it is equivalent to a duty of 2.8 ft. (that is, total consumption, as measured in acre-ft. per acre) which is little if at all greater than the average agricultural requirement in the same area. But the water conserved by superreclamation (total use less makeup water) is equivalent to about 156,000 acre-ft. annually, or a full water supply for a million population at 140 gpcd. It is reported that plant operation costs would be lowered slightly if there were means of disposing (as into an outfall sewer) of some water unsuitable for further use without expensive treatment. This water is of a quality normally considered safe from a pollution point of view but too high in concentration of soluble solids for high-temperature cooling. Thus, at other sites not overlying an important ground water basin or located nearer the ocean, the economic ratio of makeup water might be 3 or 4 per cent instead of the remarkable 2.5 per cent achieved at Fontana.

Future Industrial Requirements

The Fontana situation has been described in some detail because its present practice indicates a pattern or trend for other large industries needing great volumes of water, especially when used primarily in cooling processes, making complete reclamation relatively easy and economical. Such reclamation will be accomplished gradually in some plants, as its economic justification becomes evident. The advantage was made very obvious at Fontana by the scarcity of local water and the necessity for preventing pollution of the ground water basin in order to avoid expensive litigation. But in many Southern California industrial areas, pending or prospective ground water adjudication suits will at an early date enforce economy of water use by strict limitation of pumping. This will correct such actions against the public interest as the pumping, by large industrial plants near the Los Angeles metropolitan area, of 2–3 mgd. from badly overdrawn basins, the use of the water once for cooling and then its waste directly into storm sewers. Further control may come soon from pollution regulation, which may also serve to make industrial water reclamation appear economical.

The Fontana example also points up the great advantage, even the necessity, of water supply planning on the basis of duty-of-water data rather than per capita use records. Even the 14,000-gpcd. Vernon record becomes rational when translated into 2.3 ft. on the town's gross acreage and about 2.8 ft. on the approximate area using water from the municipal wells. (Additional water is obtained in the area from wells on industrial property.) Duty-of-water records have long been taken for granted on irrigation projects and applied with satisfactory results in their planning. It is only recently that such records have come into fairly general use for domestic and industrial water requirements, but they have long been a necessity in Metropolitan Water Dist. studies.

There is an inherent uncertainty and lack of general acceptability for large-scale design and construction purposes in forecasts of future population in-

TABLE 4

District and Coastal Plain Water Production and Requirements

Item	Region			
	District as of 1950, Excluding San Diego	Four-County Coastal Plain	District as of 1950, Including San Diego	Five-County Coastal Plain
	Area—*acres*			
Gross area	466,000	1,400,000	582,000	1,600,000
Habitable or irrigable area	410,000	1,250,000	520,000	1,440,000
Net areas served:				
1930	206,000		270,000	
1950	250,000	750,000	330,000	850,000
	Water Use, 1930—*acre-ft.*			
*Total**	398,000		430,000	
Duty per acre:				
Gross area	0.85		0.74	
Net area	1.93		1.59	
	Water Use, 1950—*acre-ft.*			
Total†	625,000	1,200,000‡	715,000	1,310,000
Duty per acre:				
Gross area	1.34	0.86	1.23	0.82
Net area	2.50	1.60	2.17	1.54
	Ultimate Annual Needs—*acre-ft.*			
Total (est.)	1,050,000	2,150,000	1,200,000	2,400,000
Duty per acre:				
Gross area	2.25	1.54	2.06	1.50
Habitable or irrigable area	2.56	1.72	2.31	1.67

* Including 45,000 acre-ft. of private pumpage in district area, as estimated from detailed surveys.
† Including estimated 50,000 acre-ft. of private pumpage in district area.
‡ Includes 700,000 acre-ft. for domestic and industrial uses, plus 500,000 acre-ft. for irrigation (besides 900,000 acre-ft. from soil moisture).

creases and ultimate per capita water requirements in rapidly growing Southern California. The increasing density of population has sharply raised the per capita requirements for industry, as a great increase in the proportion of wage earners has occurred in recent years, but such a rise in density also tends to reduce the residential and domestic per capita water uses. There is less space left for lawns and gardens, for one thing, while many incidental and governmental uses of water remain practically unchanged in amount. Of course, the chief difficulty is that no one now really knows whether the

ultimate population of Southern California will be 8-, 10- or even 15,000,000. In contrast, the average duty of water tends to approach a seemingly determinate limit as the population increases, at least for fairly large districts and for this region as a whole. That limit is about 2.5 ft., with 3.0 ft. as a liberal maximum to allow for contingencies. This is illustrated in Table 4, in which the data of Tables 1 and 2 are supplemented and duty-of-water averages are computed.

Duty-of-water data have also been determined and applied by the California Div. of Water Resources in connection with past and pending adjudication litigation. For the Pasadena basin case, the accepted consumptive use values varied downward from 2.07 ft. for residential estates and 3.33 ft. for lawns with trees, giving a basin average of 1.58 ft. Industrial uses are negligible in this basin. For pending suits in other basins, however, they become very important. Detailed field surveys are under way by both the Div. of Water Resources and, in San Fernando Valley, the Los Angeles water department. These records can only be mentioned here but will shortly make available a most accurate basis for satisfactory water use determinations.

Uncertainties cannot, of course, be entirely eliminated in forecasts of future water needs, which will be influenced by changes in standards of living or zoning and by inventions and new developments. The principal ones currently affecting water demands in Southern California, as elsewhere, are air conditioning and garbage disposers. The first may never become widely used in homes if smog improvement continues, because of the generally equable climate, but it is being found useful and profitable in many commercial and manufacturing plants, besides being inevitable for theaters, restaurants and the like. Large air-conditioning installations find it profitable to reclaim and circulate the water, making the net demand slight, but for many of the smaller ones reuse is inconvenient and impracticable. This wasted water will eventually be reclaimed and conserved along with the bulk of domestic sewage, when such reuse proves to be economical and needed as a supplemental water source. An indication of the possible effect of air conditioning is given by Las Vegas, Nev., where such installations average one to every 3.5 persons and the reclaiming of the water had to be enforced by regulation and inspection.

The convenience and popularity of garbage disposers have been amply demonstrated in this area, and they are near-standard equipment for a large proportion of new houses. Every housewife will certainly want such a gadget and the ladies generally have their way. At times the effect may be bad on sewage treatment plants, as witness the trouble encountered seasonally with fruit and vegetable canning wastes. Although water-using, they are fortunately not water-consuming in operation, so it can be safely assumed for present purposes that the resulting possibly substantial increase in per capita water requirements can be absorbed by the reclamation and reuse of water wastes for industrial processes which must be anticipated as a large-scale future development in Southern California.

Reference

1. Walasyk, Edward. Recording Customer Use of Water—Apartment Building Use. Jour. A.W.W.A., **42**:921 (Oct. 1950).

Bill Collection Stations in Large Cities

Panel Discussion

A panel discussion presented on May 22, 1950, at the Annual Conference, Philadelphia.

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HOW to make purchases, as well as pay accounts, in central locations is a problem receiving more attention each year. The increasing volume of traffic occasions a reduction of street parking at mercantile centers and, of course, a scarcity of what parking space remains. A 60,000 increase in Akron's population in the last decade brings the population total to approximately 300,000 persons, with between 500,000 and 600,000 in the metropolitan area. An aggravated downtown congestion results in the establishment of shopping centers in residential and suburban areas. These centers collect around food and drug stores, hard and soft goods businesses and financial institutions. Akron is now experiencing a marked increase in such satellite areas.

The increased operating expenses of banks, occasioned by rising costs and by wage scales which are approaching the level for similar work in industry, have resulted in the imposition of a service charge for the handling of checks. The prevailing minimum charge in Akron is 35¢ per month per account, but the charge is much higher as the number of transactions increases. In order to use a checking account without a service charge, it is necessary to carry a substantial balance and limit the number of transactions, usually to an unsatisfactorily low number. This limitation has caused many of our customers, mostly in the lower income group, to pay all their bills in cash.

Local gas, electric and telephone utilities have taken note of these changing conditions and, for the convenience of their customers, have made arrangements with certain established businesses in various sections of the city for the collection of their bills. A fixed fee, based upon the number of bills handled, is usually the basis of the contract. Lower follow-up collection costs, together with a reduced delinquency, help to compensate for the added substation expense.

For the publicly owned water utility to enter into similar contractual arrangements, however, would require legislative sanction of the city council and office supervision to insure conformity to state and charter provisions concerning bonds and depositories. Many years ago the water utility attempted to establish two branch collection offices, one a bank in East Akron and the other a real estate office in the southwest section of the city. Apparently the attempt was premature, for the need did not prove to be as great as the plan's advocates had predicted. As a result, the arrange-

ments were discontinued by mutual consent after a short trial period. The sustained patronage now enjoyed by private utility substations testifies to their value and has resulted in customer demand for the acceptance of bills for water along with other utilities.

The first current substation accepting water bills probably was the outgrowth of cashier check buying from a suburban bank. Instead of writing many checks, bills were receipted, and at the end of the day, one check was written to cover all payments—the normal collection charge paid by the customer, being required for each.

A second substation, established four or five years ago by a savings and loan association, was located in the downtown district near a bus transfer point. At its inception the Bureau of Water and Sewerage was simply advised that they were going to accept payments of bills for water, in addition to those for the other utilities, and transmit the receipts daily. They were informed that they could not be recognized officially, and that it would be necessary for them to comply with all the rules and regulations governing payment of bills by individual customers. They established a 10¢ fee to be paid by the customer for transmittal of the money. The bureau exercised no choice in this matter; the practice was not illegal, nor could their remittances be refused.

This procedure proved successful, and the demand grew for additional collecting locations. The next one was established at a savings and loan association in the northern part of the city, followed by an insurance office and a drugstore in other sections. None of these were recognized as official substations.

The extent of use is interesting. Total water and sewerage service collections for 1949 amounted to $2,465,000. Of this amount, 30.7 per cent was paid in person at the water works office, 57.7 per cent was received through the mail and 11.6 per cent was received through the mail from the collecting agencies. Of the 253,300 quarterly bills, 49 per cent was paid in person at the utility office, 29 per cent was received through the mail and 22 per cent was transmitted through the mail from self-appointed agents.

There are several advantages to these informal collecting stations. They have reduced the number of persons coming to the office for the payment of bills by approximately 30 per cent. Although this is not great enough to permit the elimination of tellers, peak loads at the tellers' windows are definitely reduced, and the public receives quicker service.

The transmittal of a group of stubs, accompanied by an adding machine tape and a single check, permits ready and rapid absorption of the stubs and check into the record of mail receipts. The one multiple remittance can be handled in about the same time as a single payment made by a customer personally. Individuals in the employ of the collecting stations become thoroughly familiar with bureau rules and regulations for payment of bills and additional information is seldom required. And, interestingly, the remittance check never bounces.

One important disadvantage in this informal procedure is that the customer is not protected. If the agency fails to remit, the bureau has no knowledge of his payment, and, of necessity, would insist upon the payment of the bills due in accord with its accounts, regard-

less of claimed prior agency payments. At times, to prove payment of a disputed bill, a receipt bearing the stamp of one of the self-styled collecting agencies is presented. Because the utility did not enter the transaction officially, it must be referred back to the payment point. Fortunately, these occurrences are rare. The rigidity of discount dates sometimes proves troublesome, also, but it has been found that loss of discount at the agency's expense usually obviates further difficulties.

At first the bureau was skeptical of the operation of diversified collections. The nominal charge to the customer of 5¢ to 10¢ per bill is less than the cost of parking in the downtown area, however, and customers have voiced no objections to the payment of these fees. The bureau's present inclination is to welcome the informal collection of water bills by any reliable agency which has contracts to collect bills for the privately owned utilities.

The problem has been a personal one to many of our customers. They have solved it voluntarily and apparently to their satisfaction. The bureau is now satisfied that satellite collecting stations have benefited its operations and improved customer relations.

M. B. Cunningham

Supt. & Engr., Water Dept., Oklahoma City, Okla.

There is something about paying a bill that causes people to put it off—sometimes until the collector comes around. These days particularly it is important to offer every aid and encouragement to the customer to pay his water bill promptly. A business transaction made easy and pleasant for customers is an opportunity to practice good public relations and to make good friends.

Experience in Oklahoma City indicates that it is desirable to use conveniently located, authorized neighborhood agencies to collect water bills. This plan is especially designed for those customers who otherwise would be inconvenienced by having to come to the main office to pay their bills.

The department serves an area of approximately 50 square miles. From the Municipal Building, where the main office is located, the water system extends north 8 miles, south 5 miles, east 3½ miles and west 5 miles.

There is evidence of the customer's preference for neighborhood shopping centers. Traffic, parking, time and convenience all favor neighborhood centers. To make it easy for customers to pay their water bills at an authorized business establishment of our selection in these areas is logical and discourages the appearance of unauthorized agents.

In the south section of the city, people are proud of the progress made in community building. For fifteen years customers living in this area have been able to pay nondelinquent water bills at their bank. Payments are prompt.

The southwest section is an industrial area with a bank and business section. For ten years a bank in this section has contracted to accept payment of water bills. Nearby employees whose homes are in all sections of the city pay their water bills here. This station has furnished a needed service to the utility's customers.

The north central section has a bank and for the past two years it has accepted payment of water bills. Many customers have expressed their appreciation for this convenient location.

There is no bank in the east section but a chamber of commerce maintains offices in a shopping center, and the water department has just completed arrangements, jointly with the gas, electric and telephone utilities, in authorizing the chamber to accept payment of its bills. The customer may thus pay all his utility bills with one check.

Another section, recently annexed to the city, has a city hall, at which it was recently arranged to accept bill payments and perform certain other city services for customer convenience. The department had its first experience with the use of neighborhood stations a good many years ago, at fire stations. The firemen were willing, but alarms interrupted the service, and the plan did not work.

Next a department cashier spent a week at a fire station in each section of town. A fire station is not a place the public has occasion to visit conveniently, however, and these trials ended in failure, and were discontinued.

Within a few months, grocers, drugstores, filling stations and other unauthorized collection agencies started accepting payments of water bills. These unauthorized agents caused confusion and sometimes payments reached the office after delinquent dates. It quickly became apparent that these "wildcatters" had to be strangled.

As a result of these experiences, and to maintain good public relations, it was decided to adopt the authorized reliable payment stations now in use. These have functioned with complete satisfaction, not only for the utility, but also for the customer.

The department pays these agencies a fixed charge, which, based on a service charge of 5¢ per bill collected, totals about $300 per month. Bills are rendered bimonthly, and about 30,000 of the 56,000 accounts are billed each month. About 6,000 bills are paid to two authorized agencies which mail the checks, along with the bill stubs collected, to the department office daily. The two new stations will probably add another 4,000, but at present 24,000 are paid directly to the main office. Of these, about half are paid by mail.

The department, always interested in any method of making it easy for the customer to pay his bill, is now adopting a new and unusually convenient plan. The idea is for the water bill to be used—by common consent—as a draft on the customer's bank account. Instead of sending the bill to the customer, the department simply deposits the bill directly in the bank, where it is considered a draft. The customer receives the bill stub along with his cancelled checks. It appears to be a wonderful plan for the busy family and a real convenience for the customer who is out of the city on business or on vacation when the bill becomes due. Experience of other utilities with this plan has facilitated the preparation of arrangements to put it into immediate use. This plan appears to be the simplest yet devised, and its success should give the utility more time to make friends and render friendly, dependable water service to its customers.

E. C. Schwier

Secy.-Treas. & Controller, Indianapolis Water Co., Indianapolis, Ind.

The collection of utility bills by local business firms has been practiced for some time in Indianapolis, but it was not until 1945 that an increase in the

number of firms rendering this service was noticed. Since then there has also been a very decided increase in the number of customers availing themselves of the service, as is shown by Table 1. The number of bills paid at these stations will vary from just a few each month at the smaller places to several thousand at the larger ones.

Approximately 135 different collection stations have now been charted in the territory served by the Indianapolis Water Co. At first it was thought that the stations were a wartime development which would not last. Just the reverse has been true, and the greatest increase has been since the war ended, with no end in sight.

TABLE 1

*Increasing Utilization of Collection Stations**

Year	Collection Stations	Water Bills Paid at Stations	Total Residential Customers Served	Ratio of Station Users to Total Customers *per cent*
1945	27	13,790	81,570	16.9
1946	37	15,530	82,503	18.8
1947	47	17,904	84,377	21.2
1948	64	20,551	87,213	23.6
1949	87	23,168	91,075	25.4
1950	99	25,051	93,871	26.7

* Figures given are monthly averages.

The charge for the service ranges from none at a few places, 2¢ per bill at a few more, 5¢ at a great number of stations, and 6¢ at only one. With 5¢ per bill the prevailing rate, it is not believed that the operators of these stations are trying to profit from the service; what is more likely is that they render the service as an inducement for people to shop in their stores and for its advertising and good will value. The charges made are therefore a matter of choice and a nickel seems to be generally satisfactory. One organization which renders this service as a part of its business of cashing checks, issuing money orders and paying other types of bills, asked the company to contribute toward the collection of these bills because it could not make a reasonable profit on the transactions, and yet felt that the customer could not be charged more than that amount. The water company declined to contribute, and currently a successor organization is charging 6¢ per bill, indicating that the 5¢ charge might be insufficient.

The company has no contract or agreement with the owners of these stations and the usual starting procedure is for the owner to come to the office, advise that he is going to start collecting utility bills, and ask what the proper routine is. He is advised that the company will not enter into any agreement with him, that he will not in any way be an agent of the company, but rather of its customers, and that no forms are furnished for reporting. To avoid a great deal of trouble, however, he is advised that no alteration of bills is permitted and that collections should be remitted daily, with the stubs.

Whether these stations are agents of the company has been debated frequently. One of the local utilities holds that the acceptance of two consecutive payments from a station automatically constitutes it an agent of the company. The other three do not agree, reasoning that these stations are agents of the customers. No issue has arisen over this distinction, but the company is careful to emphasize that payments must be made at its office, and that when made through such a station, the station is acting as the

payer's agent. When the large number of bills collected monthly by these stations is taken into account, the customer-company or station-company difficulties which sometimes arise appear slight.

Between 25 and 27 per cent of the residential customers of all utilities in Indianapolis are paying bills at these stations. There appear to be several reasons why people will spend 5¢ to pay a bill when some time during the month they no doubt will be downtown and could pay at the utility office at no extra charge. If a customer makes a trip downtown to pay his four utility bills it costs 24¢ for transportation, whereas the fee for payment at some neighborhood store would be only 20¢ and the trip downtown would be saved. Also the distance between the various utility offices in Indianapolis—approximately 6 city blocks—no doubt seems too long a walk for convenience. Still another, and probably the main reason, is that most stations will cash paychecks and the added bill collection service offers an opportunity to save time and trouble at little cost.

Some thought was given to the advisability of providing authorized stations at strategic points, and one utility—the Indianapolis Power and Light Co.—began this two years ago. An agreement was made with all banks in the city to pay them 5¢ for each bill collected, with no charge to the customer. Although there are 40 banks (including branches) located in all sections of the city, they are only collecting approximately 6,000 light bills per month, an amount representing 4.2 per cent of the utility's residential customers, whereas approximately 27 per cent are still being paid at stations which charge a fee for the service. This ratio indicates that the small amount of money involved does not determine where the customer decides to pay his utility bills.

Some peculiarities of the workings of the system are worth mentioning. From 100 to 150 bills are paid each month at the "Money Mart" located in the building next door to the company's office—not more than 150 ft. from its front door. From 5,000 to 6,000 bills are paid monthly at a large department store only two blocks away from the office.

One of the water company employees once noticed a lady standing in front of the office looking rather bewildered. Observing that she had a water bill in her hand, he asked if he could help her. When she said she wanted to pay the bill, he told her she was in front of the water company office and suggested she go in and pay it. She hesitated and explained she was looking for the Money Mart, where her husband had told her to pay the bill. With a little effort, she was persuaded to pay it at the utility's office.

Also noteworthy is the occasional clustering of stations. As many as five or six stores in one city block may collect utility bills, and yet all of them do a fairly good business.

At present the company is watching rather closely a new development. One of the large food markets has begun to collect utility bills without making a charge for the service. This chain operates about 34 stores in Indianapolis, a large number of which are supermarkets, and, having instituted the service in five of the stores, plans ultimately to offer it in all of them. The company has also received inquiries from another large food chain

which is considering the service but has not yet started. Just what this will do to the bill collecting business is uncertain, but undoubtedly food stores are patronized more often than shops merchandising dry goods, drugs or hardware. The water company is now just marking time to see how far and how fast the payment of its bills at the various stations will develop.

Paul Weir

Gen. Mgr., Water Dept., Atlanta, Ga.

Neighborhood and downtown water bill collection stations have been used successfully in Atlanta for about twenty years, and at present there are 22 of these stations in service throughout the city. Two are located in the downtown business area; the others are scattered fairly uniformly throughout the residential section.

Generally the collection station located in a shopping or commercial center and housed in a store or other place of business. Merchants say the service stimulates trade and helps to build community good will. One small store, which collected $4,000 in water bills during the last fiscal year, attributes a $1,500 increase in business to its designation as a collection station. The service is furnished without cost either to the utility or customer.

The two downtown stations are manned by full-time bonded clerks, furnished by the sponsoring firm or firms. One is a large newspaper which collects all utility bills. The other is supported by a number of firms which share an arcade location. Only water bills are collected at this station. Each station deposits all collections daily, and all stubs and a check for the day's collections are picked up each day by the city's tax office representative.

Neighborhood stations are usually located in large community drug stores. No bonded personnel is required since the firm assumes responsibility for all collections, which are usually handled by the store's regular cashier. All collecting agencies are required to stamp their identifying mark on each bill and stub. Bills are not acceptable for payment after expiration of the discount date, and any that are accepted after this date render the collection station liable for the amount of the discount lost. Of approximately 85,000 postcard water bills mailed each month, less than half of one per cent are returned as undeliverable. A cycle or day-by-day billing basis is used, with between 3,500 and 4,000 accounts billed daily. The channels through which payments are received are analyzed in Table 2.

TABLE 2

Distribution of Collections

Location	Accounts Collected *per cent*	Funds Collected *per cent*
Downtown stations	20	14
Neighborhood stations	10	6
Main office		
Counter payments	20	20
Mail	50	60

It is interesting to note that collecting stations handle about 30 per cent of the accounts contributing 20 per cent of the revenue, whereas the main office handles 70 per cent of the accounts and 80 per cent of the revenue. It has been estimated that collection station receipts are half checks and half cash, whereas the receipts at the main office are approximately nine-tenths in checks. The proportions change somewhat from zone to zone.

Neighborhood and downtown water bill collection stations have generally proved successful in Atlanta. This may be due essentially to many years of careful study of the problem and a sincere desire to serve the public better. A reliable water bill collection station system can materially supplement central office work without loss to the utility, which does not usually attempt to improve business through counter displays or store merchandising. At the same time a useful service is rendered the customer.

Gerald E. Arnold

Director, Water Dept., San Diego, Calif.

The San Diego Water Dept. has two branch offices, one in La Jolla and one in East San Diego. These and the main office in the Civic Center are the only water department offices handling turn-on and shut-off orders, in addition to water bill collections.

The department also contracts with the San Diego Gas and Electric Co. at six locations and various collection agencies at ten other locations. Five of these are drug or variety stores, three are collection agencies which also accept payment of other utility bills, one is a bank and one a real estate office. All agencies are required to report daily, using self-addressed envelopes provided by the department and mailing them at closing time for delivery the next morning.

Twelve of the sixteen agencies make bank deposits daily to the credit of the City Treasurer; the remaining four remit daily either by check or money order. All agencies are furnished with receipting-cutting boxes, forms and envelopes, and mailing and money order costs of those not close enough to a bank to deposit receipts are repaid. The collection agency's work is restricted to the collection of water bills and the issuing of duplicates, the information for which is received by telephone from the main office. Duplicate bills are issued only at the option of the agency. The agency is required to fill out Form 390, "Daily Report of Water Bill Collections," in duplicate, keeping one copy on file and mailing in the other, together with the paid cash stubs and remittance or duplicate bank deposit slip.

The department has paid a 1 per cent commission in the past for the collection service, but as a result of a recent water rate increase, new contracts have been negotiated establishing a flat reimbursement rate of 6.8¢ per bill, the average amount paid to collection agencies during the past year (*see* Appendix). Payments to the agencies are made after the close of each month's work.

APPENDIX

Collection Station Agreement

THIS AGREEMENT, made and entered into this .... day of ...., 19...., by and between the city of San Diego, a municipal corporation, acting through the City Manager thereof, hereinafter referred to as the "city," party of the first part, and ...., owner and operator of ...., at ...., ... District of the city of San Diego, party of the second part;

WITNESSETH:

That WHEREAS, it is necessary in the interest of public convenience that the city make arrangements for the pay-

ment of water bills at various locations throughout the city, rather than to require payment of such bills at the office of the City Treasurer in the Civic Center Administration Building; and

WHEREAS, the location of said business of the party of the second part is suitable for the collection of water bills, and said party of the second part is willing to act as collector for the city in collecting water bills upon the terms and conditions hereinafter set forth;

Now, THEREFORE,

IN CONSIDERATION of the premises and of the matters and things hereinafter recited, IT IS MUTUALLY AGREED as follows:

The city does hereby contract with the party of the second part, independent contractor, to collect and receive payment of city water bills on behalf of the city, and to issue receipts for such payments thereof.

The party of the second part agrees faithfully to perform the duties of collecting payments on said water bills and to account for all money collected, to the treasurer of the city, turning all money so collected over to said City Treasurer at such times and in such manner as he may direct.

In consideration of the performance of said service, the City agrees to pay, on or before the 10th day of each month, to said party of the second part, the amount of six and eight-tenths cents (6.8¢) for each collection made by said party of the second part, during the preceding month.

IT IS FURTHER UNDERSTOOD AND AGREED THAT this contract may be terminated by either the city or the party of the second part upon thirty (30) days' written notice, and that the same shall continue until so terminated.

PROVIDED FURTHER however, that this contract shall be binding only on condition that, and at such time as the party of the second part shall be bonded in the amount of one thousand dollars ($1,000.00), which bond shall indemnify the city against any loss caused by the theft or embezzlement of the said party of the second part during the period that this contract shall be effective.

IN WITNESS WHEREOF, this agreement is executed by the city, acting by and through the City Manager of said city, pursuant to and under Resolution No. .... of the Council authorizing such execution, and the party of the second part has caused this instrument to be executed this .... day of ...., 19.....

THE CITY OF SAN DIEGO,

BY ....

City Manager.

....

Party of the Second Part.

I HEREBY APPROVE the form and legality of the foregoing agreement this .... day of ...., 19.....

J. F. DuPaul, *City Attorney,*

BY ....

Deputy City Attorney.

Operating Control of Small Treatment Plants

Panel Discussion

A panel discussion presented on May 22, 1950, at the Annual Conference, Philadelphia.

R. G. Yaxley

Supt., Water Dept., Waterford, N.Y.

ONE reason why many small plants are faulty in either design, size or both appears to be lack of sufficient funds to meet the real requirements of proper construction. To a certain extent this is an engineering fault because, usually, the public wants a good job and the engineer should be able to sell the officials a plant which will give long-term satisfaction—obviously not the cheaper type. Unfortunately the statement that "The quality of engineering skill used in the design is generally in proportion to the size of the works" (1) is true far too often. The requirement that the health department approve plans in many states has brought about considerable improvement.

These problems beset the planning of new construction, but most water works men have to put up with conditions as they find them. The Waterford plant, built in 1914, is one of those designed on a production basis and cut off by the yard to meet local requirements.

That operators should have sufficient technical ability to operate their plants safely should not require discussion. When one man may hold the physical well being or even the lives of hundreds of people in his hands, he should certainly be qualified for his job. Licensing is a marked help if for no other reason than that it discourages political upsets. On the other hand a good man does not require a license to tell him what to do, while the possessor of a "Grade I" paper may be careless, indolent or worse. There are three licensed grades for operators in New York. The lowest grade certifies a man to operate plants requiring chlorination treatment only; the two higher grades are for filter plants, with the grade depending on the population served. The requirements are stiff, and graduate engineers have failed some of the examinations.

This writer must disagree strongly with Glace and Flentje on their statement that "The town should not expect its superintendent to be engineer, chemist, construction man and public relations expert" (1). The successful small plant manager is responsible for his plant from the raw water intake to the furthest dead end and is expected to answer all problems, both animate and inanimate, that may arise between those points. These may range from the design, purchase of material for, and installation of a fair sized main extension to the pacification of an irate customer whose quarterly bill has gone up fifty cents.

One ray of sunshine in the life of the conscientious operator is the status many water works enjoy of being public utilities, with their operation removed from the city hall and placed in the hands of a commission which hires the superintendent, places him in complete charge and holds him responsible for both financial and physical results. The writer has enjoyed working under this style of management for the last 29 years.

Certainly the small plant should have skilled technical advice available. Waterford has met this problem by having its bacteriological work done by a private laboratory, with the engineer in charge available as a consultant.

A tough raw water supply is just not the proper thing for an amateur chemist to play with. Furthermore the average superintendent does not have the time for this work, and laboratory equipment and supplies can run into a great deal of money. Of course, all of the routine chemical tests that are required for proper plant operation are taken care of on the job.

A word of praise should be reserved for the state health department, whose willingness to send engineers out into the field to help solve the superintendent's problems is well known. The time these men take from their regular jobs to assist with training schools and similar activities mounts up during the year. One official told the writer that he expected to be away from his office for the major part of the following three months, doing this kind of work.

A word, also, of caution to the young engineer who takes a small town job as a stepping stone on the way up. Handling a small water works successfully is a man-size job, and he may find himself in the ditch doing a job not mentioned in the book.

Francis Gosnell

Supt., Munic. Water Works, Laurel, Md.

Midway between Washington and Baltimore, on the south side of the Patuxent River, lies the small city of Laurel, a residential community which has no manufacturing worth mention. It is located in the extreme upper corner of Prince George's County, Md.—reputed to be the fastest growing county in the nation. The town of Laurel has been growing very rapidly since the close of the last war, and its population is now well above 7,000. The community owns and operates its own water plant and thus far has been able to meet the demand for water placed upon it by a growing populace.

Strangely, the supply has not been taken from the Patuxent River, a sizable stream which passes through the town, but from Bear Branch, a very small tributary located a mile distant, and limited in supply. The water plant itself, which the author has managed since 1945, is situated in the heart of Laurel.

In a recent article (1) on small water plants, the conclusion was drawn that "Small plants should be designed, as far as possible, with the principal consideration, not for the economics of design, but for foolproof operation." The Laurel plant, like many others, came into being, not overnight, or as the result of long-range planning, but a step at a time. The first step was the crude pumping of raw water from an impounding reservoir into high-pressure water mains. In the first year or two of the system's existence, water consumption averaged but 20,000 gpd., and only a few of the homes had water service. The water was not sterilized and was not considered safe for drinking.

Ten years later, a filter building was added with two 8- by 14-ft. rapid sand filters and a small settling basin—the latter actually a coagulation basin, too small and not properly designed to afford any degree of settling of solids. Small cans of chlorinated lime were used to sterilize filtered water simply by applying a can opener and dumping the contents into the clear well periodically.

Steam from the boilers of the electric utility plant in the same building furnished power for pumping. When the power plant was abandoned as being too costly to operate, a triplex plunger pump was installed, electrically driven by power obtained from a large utility serving nearby areas, and used until the plant was changed over to diesel-powered pumps.

The same diesel pumps are still in use, as are the same two small filters, the same small clear-well, the same inadequate settling basin, and the same impounding reservoir—by now largely filled with sediment, which has reduced its capacity from 25 to approximately 5 mil.gal.

Many small water plants, no less than large ones, have grown in stages to keep up with the ever-increasing demand for pure water. More or less piecemeal changes and additions, year by year, have had a marked—and harmful—effect on their ability to produce a safe, potable drinking water.

It would be wonderful if all small cities could turn back the calendar, abandon all the pieced-together facilities which they have accumulated over a period of years, and start with fresh plans. Some have been fortunate enough to do just this; many others are burdened with less satisfactory plants which they cannot afford to scrap.

Because of increasing demands, the plant in Laurel has had to operate far above its safely rated capacity. Little or no settling of floc can be obtained in the three-section around-the-end coagulation basin, and usually the two small filters must be washed after only a few hours' run. Recently 12 cu.yd. of new filter sand has been added to the filters, and the runs have been greatly increased as a result.

There have been occasions when the city council almost decided to build a new settling basin and add a new filter or two, but each time the argument that "The plant is running all right, why spend any more money?" appeared unanswerable. It is true, the staff tries to operate as efficiently as possible with the facilities available; a chlorine residual of 2.5 ppm. is maintained at the plant at all times; the pumps and machinery are kept in good operating condition; no serious interruption in service has occurred in years; and for many years the finished water has been of excellent quality bacteriologically, according to State Board of Health reports.

Plants of this gradual growth type usually become difficult to operate, especially as the demand increases. Nothing about the plant can be considered foolproof; none of the present plant features would be incorporated in a new design. The operator inherits a plant of this type with its many shortcomings and, by constantly living with it, learns its peculiarities and how best to make it function properly. The quality of water produced by such plants therefore depends almost solely on the ingenuity of the operator. On the other hand, a well designed plant—the foolproof kind—offers no such challenge to the operator. There are no exceptions to the rules of normal

operation. All emergencies are foreseen and corrective features are provided against mishaps.

Certainly small plants should be designed principally for foolproof operation, rather than economy of construction. Nearly any small community can obtain and produce an excellent water, and have the water utility stand on its own feet financially, by following these steps:

1. Obtain the best engineering service available for the design and construction of a modern, foolproof water plant, with no thought of initial economy.

2. Establish rates in keeping with water's actual value to the consumer, and comparable to the cost of other commodities considered necessities of life. A fair scale of water charges, if adopted, would enable many small utilities to provide far better water to the people they serve.

3. Reward the manager of the water utility adequately for his services. Most small operators are underpaid, and, knowing that their neighbors fare far better, many of them leave their profession to accept jobs of little importance, but at far better pay.

In order to maintain the high standing it has already achieved, the water works profession must not sell itself too cheaply. Water sold at low cost and personnel hired at poor pay do not go hand in hand with successful operation.

"Small-plant operation," Glace and Flentje (1) have said, "merits the attention of large-plant operators, and means should be found for summarizing the operating experiences of small plants." The Laurel plant produces approximately 0.5 mgd. of water and troubles and problems too numerous to mention. Every day brings different experiences. For about 25 years, daily operating records have been kept, and complete reports are on file of the total daily pumpage; number of hours run; amounts of alum, lime and chlorine used; residual chlorine results recorded; turbidity; pH of raw and filtered water; time plant started each day and water pressure at plant at time of starting; time plant stopped at night and pressure at plant at the time of stopping; weather condition; air temperature; list of supplies received each day; visitors registered; and any unusual occurrences. Graphs and charts show the increase in consumption over the years. At the end of each fiscal year a report of the cost of operating the plant is prepared which includes a completely itemized breakdown of every operating expense. This yearly report has proved of immense value to the city council.

As superintendent of the plant, the author is very much interested in the stories of other water works engineers, many of which he reads in the water works journals. To learn what problems are faced by other men in the profession and exchange experiences with them is an ideal way of improving one's own worth. It is very fortunate that in recent years the large-plant operators have shown a keen interest in small-plant men. The plants may be small, but their number is legion, and the population they serve is considerable.

The members of the large plant's staff are by necessity specialists in their individual lines of work. Small plant operators are something like country doctors, who "specialize" in general practice. Many of them do not have all the training or schooling called for by their responsible positions. They do the best they can, but sometimes it

is not enough. Certainly any encouragement and help they receive from those in the professional ranks will be gladly received—and well worth the givers' while in the end.

C. R. Ridington

Supt., Lansdale Munic. Authority, Lansdale, Pa.

Those unique Pennsylvania corporations known as Pennsylvania municipal authorities can be described as publicly owned private utilities—"public" in the sense that the members of each authority board are appointed by the borough council, and that eventually, when the bonds are redeemed, the works will come under direct municipal ownership; and "private" because the control and operation of the works, including its funds and management, are solely in the hands of the authority, and thus are as completely divorced from the other activities of the borough as if it were a water company.

The author has been successively employee, manager and superintendent of the Lansdale works for nearly 24 years, serving as manager and superintendent under three types of ownership: local private ownership, absentee private ownership, and now quasi-municipal ownership. During these years, daily consumption at Lansdale has increased steadily from about 250,000 gpd. to 850,000 gpd.—just about the upper limit of the "small works" classification set by Glace and Flentje (1).

The Lansdale plant has no really serious purification problem, but there are somewhat unusual conditions requiring very close control. The community is situated in a broad plain at the extreme headwaters of several small streams (the Wissahickon, the Neshaminy and the Towamencin Creeks), so that the only water economically available is from underground sources. There are now 67 deep wells in the area, all drilled into the underlying sand and shale rocks, and, of these, the authority owns and maintains 17 for regular or intermittent use. These are scattered so widely as to require the use of separate pumps and 11 distinct chlorination units, the latter of the Wallace and Tiernan type, all equipped with feed pumps for forcing the chlorine solution into the distribution mains against normal pressures. All water from the wells is pumped directly into the distribution mains, with pressure relief and balancing provided by two steel standpipes, one located near the center of the borough and the other almost a mile to the east. Obviously the capital cost, operation and maintenance costs, and service requirements for these scattered units pose a difficult operational problem.

Chlorination is the only purification process. The raw well water is clear, cold, slightly hard—about 130 to 150 ppm.—noncorrosive and occasionally contaminated just sufficiently to require disinfection for safety. Most of these wells, when constructed, were located on the edges of the developed areas of the community, with no service connections nearby. As the borough grew, many of the wells were completely surrounded by dwellings, and some service connections were made so close to the point of chlorine application that the chlorine contact time from the pump to the consumer is limited to a matter of minutes. Hindsight is, of course, superior to foresight, and if present conditions could have been anticipated, it is obvious that grief and labor could have been spared by adopting the suggestion of Glace

and Flentje (1) to deliver the raw water from the wells into receiving basins at selected points for proper disinfection before pumping it into the distribution system. Under present conditions any considerable dose of chlorine immediately causes consumer complaints, and extremely close and persistent control is necessary, with residuals maintained at 0.05 to 0.08 ppm. at the wells to prevent complaints. Admittedly this is an extremely light dose.

Scattered as the units now are, the collection of the various pump discharges into one or possibly three or four receiving wells would require a considerable investment. Fortunately the raw well water is normally uncontaminated and of excellent quality, and has a low chlorine demand. Should the sources become seriously and dangerously contaminated, it is possible that the authority would be driven to adopt such a project.

The authority is well staffed, has an adequate accounting system and two consulting engineers on its part-time staff, one of them a water purification specialist. It is inconceivable that any water works could be operated properly without proper engineering and technical services. Such services, particularly under absentee ownership, have not always been provided. The present ownership has made possible the following of good practice, including conformance with state health department regulations.

J. H. Bartholomew

Mgr., Atlantic County Water Co. of N.J., Pleasantville, N.J.

The Atlantic County Water Co. of New Jersey is a corporation in its own right, affiliated with the parent Northeastern Water Co. and American Water Works Co., whose subsidiaries comprise two service companies and 117 operating water companies. Operation of subsidiary utilities is supervised by a service organization, the American Water Works Service Co., operating through its main office in Philadelphia, and 5 division offices. The services rendered by this company embrace plant design, supervision of all operating problems, financing, plant and property protection, the development of new water sources, design of collection, pumping and purification facilities, and similar services for transmission and distribution systems, metering, purchasing and the furnishing of legal, commercial and management advice. The service company also edits and publishes a house organ known as *H_2O*. This is not only a periodical for the recording and dispersing of individual plant news but also a medium for the expression of employee views and suggestions.

All these services are available to the small as well as the larger plants and, as has been indicated, the services rendered are not always purely technical. From their work on the design and study of new additions, from operating reports which they received periodically from the local managers, and from frequent plant visits which they make, the service company representatives become familiar with each plant in the system. They are available for immediate assistance in times of trouble and in an emergency can even act as plant operators. The service company naturally supervises the expenditure of considerable sums of money each year. Generally, these expenditures are the result of recommendations submitted by the local man-

ager, on the basis of which an investment budget schedule for each plant is established. This is done under the direction of the department heads of the service company and is approved by the directors of the parent company.

To assist in the financing of these expenditures, the monthly cash requirements are forecast, and commitments may not be made that require expenditures earlier than those set forth in the schedule. Having an investment budget schedule, however, does not permit plant operators to make installations promiscuously. Except for certain maintenance jobs, all construction work is done through work orders (generally prepared by the plant operators) after approval by the proper department of the service company.

Probably the best way to note the effect of this method of supervision on a small plant is to describe the Atlantic County Water Co. and the solutions worked out to a few of its problems. The Company has been in existence since 1901 and its almost 100 miles of mains serves the territory, just beyond the tidal flats west of Atlantic City, extending from Absecon on the north to Somers Point on the south. Of two sources of supply, the original is a surface source impounded by the construction of a dam on Patcong Creek. The watershed area of about 11 square miles above the dam has an estimated minimum runoff of 6 mgd. This supply is chlorinated but not filtered before delivery to the distribution system. At times, however, the water has considerable color, and, for this reason, during the last several years, has been held as a secondary supply for use only in an emergency.

The main source of supply is ground water secured from pumped wells, two located in Pleasantville, one in Northfield and two in the city of Somers Point. With the exception of the one in Northfield, all of the wells were originally Kelly type cased and screened, 16 to 24 in. in diameter and from 118 to 160 ft. deep. Two of these have been converted into, and one replaced by, gravel-packed wells, reducing the 16-in. wells to 10 in. and the 24 in. to 12 in. size. Preliminary work for the replacement of another well has been completed. The fifth, or Northfield, well is a rotary drilled, gravel-packed type, placed in service during 1949 as an additional supply. The redesign of the wells, although it reduced the size of the wells, did not impair their delivery, but it did eliminate all sand pumping, so prevalent in the area. Motor-driven centrifugal pumps of high efficiency were chosen by the system's designers, and their status as specialists carried sufficient weight with the manufacturer, when they objected that specifications were not met, to have him replace two new units.

A convincing demonstration of the need for specialists and their technical services is afforded by the failure of one of the Pleasantville units. The difficulty was experienced during the last period of material scarcity. All of the trouble started with the apparent crystallization of the motor pilot-bearing which resulted finally in the complete destruction of the thrust bearing and motor stator. After consultation with the engineering department, it was discovered that replacement parts for this type of pumping head were not available for ninety days, plus the shipping time involved by delivery from the West Coast. Without field inspection, an adapter plate was designed by the engineers to accept an entirely different type of motor which was available immediately, resulting in an interruption

of delivery from this station of less than 72 hours.

Later the same year, and during the peak pumpage period, the Kelly well screen of this delivery point failed. Within 24 hours, the required material to recase and rescreen the well had been located and a skilled representative had arrived to supervise the sand bucketing, the casing and screen installation, and to determine the proper grade of gravel to be placed between the old and new casings. Knowing that the new casing would not accommodate the old pump and column, the engineer, through inventory records of affiliated plants, had located a pump and motor of suitable size and capacity, which arrived before the well work had been completed. The borrowed pump had the aboveground type of discharge, whereas the original piping was arranged for underground output; but by a neat job of welding the new pump was adapted to the original setting.

During a hydraulic survey by the engineers, it was determined that the capacity of approximately 22,000 ft. of feeder mains along Shore Road had been reduced greatly by iron tuberculation. A program was instituted, designed to improve the service for the entire length of the city of Linwood and for the most of Shore Road in Somers Point. Realizing that the cleaning of these mains would only increase "red water" difficulties, the sanitary engineers followed up with a color-preventive program. The injection of an anticorrosive solution at all delivery points presented no difficulty. To obtain the desired form of treatment material was a problem, however, until long after the program had been completed. As only an anhydrous form of material was obtainable for the treatment units planned, it became necessary for these engineers to design solution tanks that would handle the resultant crystallization of this almost insoluble material. Though results of the original treatment were gratifying, all are thankful that "Ready Soluble" hexametaphosphate is now plentiful.

Each of the automatic stations was designed for "overnight" application of chlorine should sterilization of these ground sources become necessary. Plant designs have also been discussed offering complete treatment of the surface water supply should there be a drop in the present water table.

There are too many water works for a sufficient number of operators to be immediately available with the necessary qualities for individually designing and operating each small plant. "Jack of all trades but master of none" applies to most operators of water works and, too often, the activities of such operators cause higher unit costs than are necessary. The arrangement under which the Atlantic County Water Co. operates accomplishes, in the author's opinion, many of the objectives recommended by Glace and Flentje (1), that is: utilization of experienced local personnel, provision for specialized technical assistance without excessive cost, and ready access to a consulting organization of experienced water works engineers.

Reference

1. Glace, Ivan M. & Flentje, Martin E. Design and Operational Problems of Small Water Plants. Jour. A.W.W.A., **41**:616 (July 1949).

Factors Influencing Bactericidal Action of Ultrasonic Waves

By M. P. Horwood, J. P. Horton and V. A. Minch

A contribution to the Journal by M. P. Horwood, Professor of Sanitary Science; and J. P. Horton and V. A. Minch, Research Assistants; all of Dept. of Civ. & San. Eng., Massachusetts Institute of Technology.
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WAVELENGTHS of sound, like wavelengths of light, may be arranged linearly in the form of a definite spectrum. The sound spectrum may be divided roughly into three portions, only one of which is audible to the human ear. Audible frequencies occur in the range between 20 and 18,000 cps. (cycles per second). Below 20 cps. are the subsonic frequencies which are too low for the human ear to hear. Ultrasonic frequencies are those above 18,000 cps. Because the ear does not respond to these frequencies, it is possible to work without discomfort in the presence of sound intensities billions of times as great as those experienced in the audible range.

That ultrasonic vibrations are lethal to bacteria has been demonstrated in the laboratory by many investigators. Wood and Loomis (1) stated that they had been able to destroy or disrupt some of the larger microorganisms such as filaments of spirogyra with ultrasonic vibrations, but that bacterial forms could not be destroyed because they were so small. Harvey and Loomis (2) reported, however, that *Bacillus fischeri* could be destroyed with ultrasonic vibrations and noted the destruction by the loss of luminescence in the bacterial suspension. Williams and Gaines (3) reported that suspensions of *Esch. coli* could be destroyed by sound waves at a frequency of 8,800 cps. These and other investigators have indicated that the shape and composition of the container as well as its location with respect to the sound generator have important effects on the results obtained.

The specific effects of proteins, carbohydrates, fats, inorganic turbidity and color on the germicidal properties of ultrasonic vibrations have not been determined. Similarly, the effect of pH, temperature, initial concentration of organisms and other factors must also be evaluated in studying the germicidal effects of ultrasonic vibrations. It is assumed that the significance of the various factors influencing the germicidal properties of ultrasonic vibrations will have to be determined before this process can be applied to the treatment of water, sewage or any other medium for disinfection.

This discussion deals with the effects of age of culture, bacterial concentration and environmental temperature on the germicidal properties of ultrasonic vibrations against *Esch. coli.*

Apparatus

The general arrangement of the apparatus ("ultrasonorator") used in this research is shown in Fig. 1. Figure 2

shows a closeup of the transducer with the test cell in place. The cell consists of a high-quality stainless-steel tube $8\frac{1}{2}$ in. long, with an inside diameter of $1\frac{1}{8}$ in. This tube is surrounded by a second stainless-steel cylinder which is separated from the first by an annular space $\frac{3}{32}$ in. wide. This annular space is sealed at the top and bottom and acts as a passage around the cell for the recirculating cooling water, which enters the jacket at the bottom and leaves through the fitting at the top. The bottom of the test cell is sealed with a cellulose acetate diaphragm 0.002 in. thick.

The "piezo" quartz crystal which is the source of the vibrations is mounted in the battery jar and is surrounded with transformer oil. The crystal has an effective area of 7.07 sq.cm., which produces between 50 and 60 acoustical watts of energy when the maximum voltage of approximately 30,000 v. is applied across the crystal. An indication of the intensity of vibrations is offered by Fig. 3.

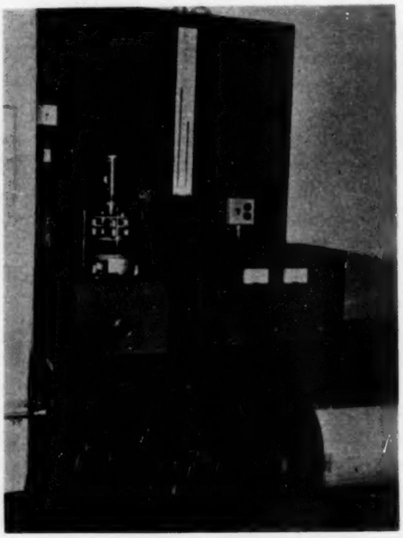

Fig. 1. Arrangement of Apparatus

The two main generating units produced by the Crystal Research Laboratories of Hartford, Conn., are shown on top of the table. The unit on the right converts a constant-voltage line current into high-frequency (400-kc.), high-voltage alternating current. The transducer on the left converts electrical energy to sound energy. The refrigerating unit used to supply cooling water is shown below the table.

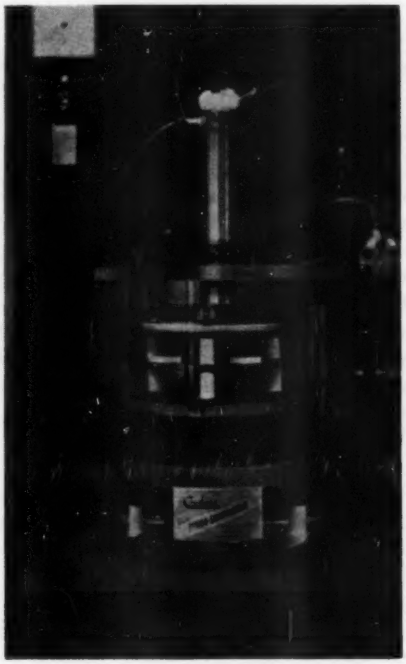

Fig. 2. Transducer With Test Cell

The test cell, consisting of two concentric stainless-steel cylinders, is held in place by screw threads which connect it to the lucite plate mounted on top of the battery jar.

Some difficulty was experienced initially in determining the proper type of temperature-measuring device. If a thermometer were placed in the active sound field, the vibrations would be transmitted to the mercury column, which would oscillate appreciably, thus preventing accurate temperature measurements. The use of a thermocouple was considered, but, since the device might pick up the radio frequency energy, it was concluded that the cost of filtering out stray currents would be prohibitive. The apparatus finally selected, which has given satisfactory service, is a chromium-plated, gas-filled bulb connected to a distant-reading thermometer. The thermometer indicator is activated by a typical Bourdon gage arrangement with the dial calibrated in degrees Fahrenheit.

Fig. 3. Effect of Ultrasonic Vibrations
This spectacular vapor-filled fountain was produced by the ultrasonic vibrations of a quartz crystal immersed in transformer oil.

The rate of flow of cooling water through the circuit is controlled by a valve and is indicated by a Venturi meter and mercury manometer. The refrigerating apparatus can be set to maintain the cooling water at a predetermined degree of heat so that any desired environmental temperature may be obtained within the cell.

Analytical Procedure

The procedure employed in these experiments has been to grow 24-hour nutrient broth cultures of *Esch. coli* at 37°C. after making transfers from an actively growing culture, using a platinum loop with a diameter of 3 mm. After one loopful of the growing broth culture had been transferred to a new tube, the remainder was used for preparing the bacterial test suspensions. By adopting this procedure, it was possible to obtain any desired concentration of organisms per milliliter when diluted with proper volumes of sterile buffer solution. The desired quantity of culture was suspended in 100 ml. of sterile buffer solution and thoroughly mixed, and the resulting suspension was then placed in the test cell, where it was exposed to ultrasonic vibrations for one hour.

During the course of the treatment, samples were withdrawn from the test cell at definite intervals and plated on nutrient agar in triplicate after making suitable serial dilutions. The agar plates were incubated at 37°C. for 48 hours and counted with the aid of a Quebec Colony Counter.* When samples were withdrawn from the test cell, sterile buffer solution was added to

* Made by American Optical Co., Buffalo, N.Y.

make up the loss in volume, as it was known that the volume of the sample had an appreciable effect on the results obtained.

Every test was repeated at least ten times so that sufficient information would be available to yield statistically reliable results.

Effect of Age

Experiments were also conducted on *Esch. coli* in other than the one-day-old culture mentioned above, in order to determine the effect of the age of the culture on the killing rate. One-, three-, seven- and eight-day-old cultures were exposed in the ultrasonorator. The results demonstrated that, with the ages of the cultures employed, the older the culture, the more susceptible it was to ultrasonic vibrations. With the eight-day culture, sterility was obtained when it was "sonorated" (subjected to sonic vibrations) for only 25 minutes. On the other hand, the standard one-day culture, sonorated for 60 minutes under identical conditions, still contained 0.05 per cent of the original number of viable organisms present. Although this residual concentration of living cells may seem insignificant, it means approximately 400 organisms per milliliter because of the high initial concentration employed. It is possible to conclude, therefore, that the age of the culture is a significant factor in the lethal effect of ultrasonic vibrations on bacteria and that older cultures are less resistant than younger cultures.

This effect of age of culture in sonoration differs from that in chemical disinfection, in which the young cultures, which are in the logarithmic growth phase, are generally more susceptible.

The results of the experiments on the effect of age of culture on the killing rate of ultrasonic vibrations obtained in this investigation are at variance with those reported by Chambers and Gaines (4) in 1932. Comparing the bactericidal action on 12- to 48-hour cultures of *Esch. coli* with that on 5- to 14-day cultures, they reported that the lethal effects of ultrasonic vibrations varied inversely with the age of the cultures and not directly, as observed in the present experiments.

Unfortunately, such variations in observations are encountered frequently in ultrasonic research. Usually the explanation may be found in the differences existing in the equipment em-

TABLE 1

Effect of Initial Concentration

Initial Concentration of *Esch. coli* per ml.	Time—min.							
	1	3	6	10	15	25	40	60
	Organisms Surviving—*per cent*							
6,080,000	89.0	59.8	32.6	19.7	11.4	2.62	0.451	0.067
628,000	79.5	60.5	29.9	18.6	10.0	2.65	0.396	0.035
66,800	80.2	54.7	30.6	16.7	9.6	2.93	0.473	0.056
6,480	77.7	60.6	34.7	19.3	11.1	2.57	0.559	0.062

ployed by the various investigators. Chambers and Gaines used a magnetostriction rod generator operating at a frequency of 8,900 cps., whereas in the present work the generator was a quartz crystal vibrating at 400 kc. per second. The basic explanation of the variation in results, even considering the different types of generating equipment employed, is not immediately apparent, however. Theoretically, the means of generating the ultrasonic vibrations should not have any effect on age-kill relationship of bacterial cultures. The authors' work has demonstrated that the age of the bacterial culture does have an important effect on the killing rate, and, accordingly, it is desirable in this sort of investigation to use cultures of the same age throughout the investigation.

Having determined that young cultures are more resistant to ultrasonic treatment than older ones, it was decided to conduct this investigation on 24-hour cultures, since the lethal effects produced on them would be equally applicable to older cultures. Furthermore, by varying the initial concentration of viable cells from a 24-hour culture, it was possible to determine the effect of initial cell concentration on the killing rate of ultrasonic vibrations.

Effect of Concentration

The influence of the initial concentration of viable cells on the killing effect of 400-kc. ultrasonic vibrations at a temperature of 60°F. is indicated in Table 1. The initial concentration varied between 6,000 and 6,000,000 per milliliter. The results show that there was no appreciable variation in the killing rate for any interval of time employed. It may be concluded, therefore, that, within the limits of the concentrations employed, the initial bacterial population is not a significant factor in determining the rate of germicidal action when ultrasonic vibrations are employed.

Although the initial concentration of bacterial cells does not influence the killing rate of ultrasonic vibrations, other factors indicated that an initial concentration of approximately 70,000 organisms per milliliter would be most desirable. Such a concentration was easy to prepare, and serial dilutions for counting could readily be made. Accordingly, unless otherwise speci-

TABLE 2

Effect of Environmental Temperature

Temp. °F.	Time—min.							
	1	3	6	10	15	25	40	60
	Organisms Surviving—*per cent*							
45	82.1	61.1	39.5	23.1	14.6	6.22	1.23	0.218
60	80.2	54.7	30.6	16.7	9.6	2.93	0.473	0.056
75	73.5	52.8	23.1	12.7	6.00	1.06	0.139	0.016
85	70.4	37.2	15.9	6.44	2.32	0.353	0.0313	0.0027
98	62.5	32.4	10.1	3.00	0.751	0.047	0.0071	0.0000

fied, this concentration was employed in the work reported below.

Effect of Temperature

Because temperature generally affects the rate of disinfecting action, it was considered important to determine quantitatively the relationship of the

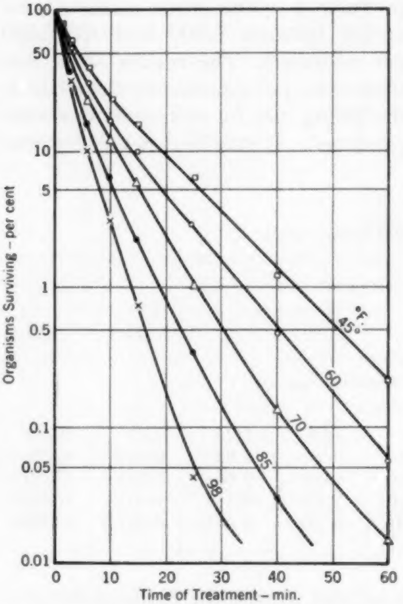

Fig. 4. Environmental Temperature Factor

The approximate equation of the above curves is:

$$N = N_0 e^{-kt}$$

in which N *is the number of bacteria at any time,* t; N_0 *is the initial concentration of bacterial cells and* k *is a constant.*

environmental temperature of the bacterial suspension to the rate of germicidal action produced by 400-kc. ultrasonic vibrations. The results of this series of experiments are shown in Table 2 and Fig. 4.

The curves in Fig. 4 indicate that the typical logarithmic relationship, $N = N_0 e^{-kt}$, is approximately applicable. The constant, k, depends on factors such as age of culture, power applied and environmental temperature. This relationship apparently does not hold strictly throughout the entire range of germicidal action. When the bacterial survivors become greatly diminished, the curve tends to level out and the killing rate is lessened.

The data in Table 2 show that the higher the environmental temperature, the more rapid is the killing rate. The difference in rates is quite striking. Complete sterility was obtained after 60 minutes' sonoration when the environmental temperature of the culture was 98°F. At this temperature, sterility was also obtained in several runs after sonoration for only 40 minutes. In some runs conducted at 38°F. but not reported here, it was observed that even after 60 minutes of ultrasonic treatment, 10 per cent of the original concentration of viable bacterial cells was still recoverable.

Since a temperature of 98°F. is favorable to the growth of *Esch. coli* and the bacterial suspension used in these experiments contained some culture medium—nutrient broth—it was decided to determine whether there was any appreciable increase in viable cells in a control suspension kept at 98°F. for one hour. Control samples were withdrawn periodically during the hour and plated in the same manner as the treated samples. The results indicated that the change in bacterial concentration during this time was negligible. Therefore, the marked increase in the rate of germicidal action at higher temperatures could not be attributed to temperature alone, but was unquestionably due to a combination of temperature and ultrasonic vibrations.

One possible explanation for the effect of environmental temperature on

the bactericidal rate of ultrasonic vibrations is that cavitation is the destructive mechanism. Shumb, Peters and Milligan (5) have shown that the intensity of cavitation, as measured by the amount of metallic damage, increases with the temperature up to about 130°–140°F. Above this temperature, the intensity decreases with increasing temperature. The nature of *Esch. coli* is such that environmental temperatures higher than 140°F. have no significance so far as the temperature-sonoration relationship is concerned, since the thermal death point of the organism is slightly above this temperature. But below 140°F., the germicidal effect of ultrasonic vibrations increases with the temperature. The explanation of the relationship may be that the intensity of collapse of the cavitation bubble for any given sound intensity increases with the temperature up to approximately 140°F.

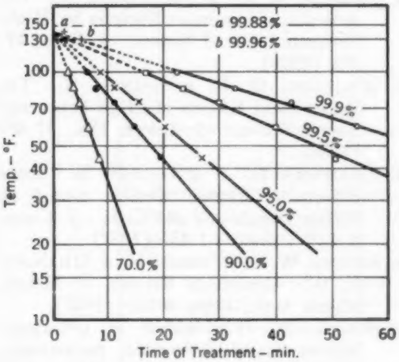

Fig. 5. Temperature and Treatment Time

The convergence of these curves at 140° F. indicates that the time required to obtain sterility at this temperature with ultrasonic vibrations approaches zero.

After the treatment had been completed, samples were examined microscopically under the oil immersion lens, but the degree of magnification was not sufficient to allow a proper evaluation of the mechanism of destruction.

Hamre (6) presents electron microphotographs which seem to indicate that living cells are killed by ultrasonic vibrations as a result of the destruction of a small portion of the cell wall and the subsequent diffusion of the cell contents into the surrounding medium.

Figure 5 indicates the time-temperature relationship necessary to achieve any specified degree of kill for *Esch. coli.* The plot shows several points taken from the curves of Fig. 4. Extension of these equal killing gradients shows that, barring discontinuous functions, all the lines intersect in a point at approximately 140°F. Almost instantaneous sterilization should be obtained at this temperature.

In the apparatus used in this investigation, it was difficult to maintain an environmental temperature of the bacterial suspension at 140°F. Nevertheless, because of the basic significance of the curves in Fig. 5, a series of runs was made, which showed a percentage survival of 0.040 at 131°F. after five minutes and 0.119 at 140°F. after two minutes. It should be noted, however, that the temperatures varied by 1 or 2 per cent on either side of the recorded value. Even under these circumstances, the results appear to substantiate the prediction of the curves—namely, that it would be possible to obtain almost instantaneous sterilization at 140°F. with ultrasonic vibrations.

There are obviously various factors which might influence this phenomenon of instantaneous sterilization at a relatively low temperature. This study was limited to the use of a clear, aqueous suspension of a pure culture of *Esch. coli.* Turbidity, color, organic matter, pH and other variables might

affect the germicidal results. Furthermore, the intensity of the ultrasonic vibrations employed is not definitely known, but it is believed to be in the neighborhood of 15 acoustical watts per square centimeter at the sample, as determined by a Siemens power meter.

Summary

Quantitative investigations have been conducted on the lethal effects of ultrasonic energy at 400 kc. on aqueous suspensions of *Esch. coli.* The results obtained show that:

1. The age of the bacterial culture affects the rate of germicidal action. The younger cultures (24 hours) were more resistant to ultrasonic energy than the older ones (168–192 hours).

2. Within the limits of the initial bacterial concentrations employed—6,000 to 6,000,000 organisms per milliliter—the germicidal rate of ultrasonic treatment is independent of the initial concentration.

3. The environmental temperature of the bacterial suspension alters the killing rate. The higher the temperature, the more rapid is the rate of germicidal action. At 98°F., complete sterility is obtained after sonoration for 60 minutes.

4. When the environmental temperature of the treatment is 140°F., it appears possible to obtain almost instantaneous sterilization of aqueous suspensions of *Esch. coli.*

References

1. Wood, R. W. & Loomis, A. L. The Physical and Biological Effects of High-Frequency Sound Waves of High Intensity. Phil. Mag., Series VII, **4**: 417 (1927).
2. Harvey, E. N. & Loomis, A. L. Destruction of Luminous Bacteria by High-Frequency Sound Waves. J. Bact., **17**: 373 (1929).
3. Williams, O. B. & Gaines, N. The Bactericidal Effects of High-Frequency Sound Waves. J. Infect. Dis., **17**:485 (1930).
4. Chambers, L. A. & Gaines, N. Some Effects of Intense Audible Sound on Living Organisms and Cells. J. Comp. & Cell Physiol., **1**:451 (1932).
5. Shumb, W. C.; Peters, H. & Milligan, L. W. Cavitation Erosion of Metals. Metals and Alloys, **8**:126 (1937).
6. Hamre, D. The Effect of Ultrasonic Waves Upon *Klebsiella pneumoniae, Saccharomyces cerevisiae, Miyagawanella felis* and Influenza Virus A. J. Bact., **57**:279 (1949).

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American Water Works Association

Tentative
STANDARD SPECIFICATIONS
for
POWDERED ACTIVATED CARBON

These "Tentative Standard Specifications for Powdered Activated Carbon" are based upon the best known experience and are intended for use under normal conditions. They are not designed for use under all conditions and the advisability of use of the material herein specified in any water treatment plant must be subjected to review by the chemist/engineer responsible for operations in the locality concerned.

Approved as Tentative by the Board of Directors of the A.W.W.A. on July 11, 1949

First Printing, February 1951

AMERICAN WATER WORKS ASSOCIATION
Incorporated
500 Fifth Avenue, New York 18, N.Y.

Tentative

Standard Specifications for Powdered Activated Carbon

Part A—Material Specifications

Sec. 1A—Scope

These specifications cover powdered activated carbon for use in the treatment of municipal and industrial water supplies. The specifications are intended for use in connection with Part B (Sampling, Inspection, Packing and Marking) and Part C (Testing Methods) of this document.

Sec. 2A—Caution in Handling and Storage

Powdered activated carbon should be handled as a potentially combustible material. It should be stored in a building or compartment as nearly fireproof as possible. Nothing else should be stored in the same building or compartment. Quicklime, chlorine, hypochlorites and potassium permanganate are especially dangerous in contact with carbon. Carbon feeder rooms should be equipped with explosionproof electrical outlets, lights and motors.

Sec. 3A—Definition

Activated carbon is a charred or carbonized residue of an organic material. It is produced and prepared for use in such a way as to possess a highly adsorptive capacity, particularly with respect to taste- and odor-producing substances in water.

Sec. 4A—Sampling

Sampling shall be conducted in accordance with Part B (Sampling, Inspection, Packing and Marking) of this document.

Sec. 5A—Methods of Testing

The laboratory examination shall be carried on in accordance with Part C (Testing Methods) of this document.

Sec. 6A—Impurities

The powdered activated carbon supplied under these specifications, shall contain no soluble mineral or organic substances in quantities capable of producing deleterious or injurious effects upon the health of those consuming the water, or that would otherwise render unfit for public water supply use the water, which has been treated properly with the powdered activated carbon.

Sec. 7A—Rejection

7A.1. Notice of dissatisfaction with a shipment, based on the specifications, must be in the hands of the consignor within ten days after receipt of the shipment at the point of destination. If the consignor desires a retest, he shall notify the consignee within five days of notice of the complaint. Upon receipt of the request for a retest, the consignee shall forward to the consignor one of the sealed samples. In the event that the results obtained by the consignor, on retesting, do not agree with the results obtained by the consignee, the other sealed sample shall be forwarded, unopened, for analysis to

a laboratory agreed upon by both parties. The results of the referee analysis shall be accepted as final and the cost of the referee analysis shall be paid for by the party whose results show the greatest discrepancy from the referee results, or if the shipment is rejected on the basis of the referee analysis, the cost of such referee analysis shall be borne by the consignor. In referee analyses based on the threshold odor test, the exact procedures to be followed shall be agreed upon by both consignor and consignee and made a part of the original specifications.

7A.2. On the basis of the retest or the referee test, the consignor may remove the material from the premises of the consignee, or a price adjustment may be agreed upon by the consignor and consignee, in accordance with Sec. 7A.3 or 7A.4 below.

7A.3. If the phenol value is more than 10 per cent greater than the guarantee or specifications, or if the carbon fails to produce taste and odor removals equal to the original bid sample within the limits of accuracy of the test, there shall be a penalty adjustment in price. When better carbon than called for by the guarantee or specifications is furnished by the consignor, provisions for premium payment shall be optional with the purchaser.

7A.4. Any one of the following shall constitute cause for rejection of a shipment:

a. A phenol value of more than 30 when the phenol value of the carbon to be supplied is not included in the specifications.

b. If the phenol value is more than 33 per cent greater than the guaranteed value.

c. If the taste and odor removal, as measured by the threshold test, is less than 70 per cent of the bid or reference sample, as guaranteed.

Sec. 8A—Moisture

The moisture content of activated carbon when received shall not exceed 8 per cent by weight, unless otherwise specifically agreed upon by consignee and consignor.

Sec. 9A—Fineness

The powdered material shall be of such fineness that not less than 99 per cent will pass a 100-mesh sieve and not less than 95 per cent will pass a 200-mesh sieve, as tested by the wet-screen method.

Sec. 10A—Adsorption Capacity

The adsorption capacity shall be determined by the use of the standard phenol test or by the measurement of the threshold odor reduction in the water to be treated.

Sec. 11A—Bid or Reference Sample

Since the determination of the phenol number of a carbon and the threshold odor number of samples of water are not precise and variations may occur between laboratories, it is necessary that the seller's laboratory and the purchaser's laboratory come to an agreement on a "reference sample" before it is established as such. Thereafter, it shall be preserved, sealed, and used for comparison of laboratory procedures in the event of disagreement between seller and purchaser on the quality of a shipment. Since the manufacturer's guarantee is based on the bid sample, it is recommended that the bid or reference sample be of sufficient size (at least 2 lb.) so that it can be used as a reference for checking carbon shipments and laboratory test methods.

Recommended forms of certificate of guarantee are shown in Fig. 1.

Option A

Date__________

(To Whom It May Concern:)

We are prepared to furnish for shipment to the__________ Water Purification Plant in the City of__________, State of __________, against their requirements of activated carbon, our product (Trade Name of Product), having the following uniform specifications:

Fineness:

Per cent passing 100-mesh screen................__________
Per cent passing 200-mesh screen................__________
Per cent passing 325-mesh screen................__________

Carbon content..................................__________
Moisture—not more than........................__________
Density—weight per cubic foot, packed.............__________

Phenol value:

__________parts per million (Trade Name of Product), or less, will reduce the phenol from a concentration of 100 parts per billion to 10 parts per billion when stirred for one (1) hour at 100–300 rpm., at normal room temperature of 20° to 25°C., using distilled water solutions with pH of approximately 7.0.

It is agreed that a shipment may be rejected if the phenol value is more than 33 per cent greater than the original bid sample or guarantee.

It is guaranteed that the carbon to be supplied will retain its adsorption capacity after being properly stored in the plant for a period of 120 days.

All the above tests are to be conducted in accordance with the specifications of the American Water Works Association for powdered activated carbon.

(Name of Firm)

*Signed by:*__________(Authorized Agent)

(Notarized)

Option B

Date__________

(To Whom It May Concern:)

We are prepared to furnish for shipment to the__________ Water Purification Plant in the City of__________, State of __________, against their requirements of activated carbon, our product (Trade Name of Product), having the following uniform specifications:

Fineness:

Per cent passing 100-mesh screen................__________
Per cent passing 200-mesh screen................__________
Per cent passing 325-mesh screen................__________

Carbon content..................................__________
Moisture—not more than........................__________
Density—weight per cubic foot, packed.............__________

Phenol value:

__________parts per million (Trade Name of Product), or less, will reduce the phenol from a concentration of 100 parts per billion to 10 parts per billion when stirred for one (1) hour at 100–300 rpm., at normal room temperature of 20° to 25°C., using distilled water solutions with pH of approximately 7.0.

Threshold odor test. It is agreed to submit our product to the direct comparative evaluation on the threshold odor basis with other competitive carbons.

It is further agreed that a shipment may be penalized if it fails to produce taste and odor removals equal to original bid or reference sample, and may be rejected if it fails to produce taste and odor removals equal to 70 per cent of the original bid sample.

It is guaranteed that the carbon to be supplied will retain its adsorption capacity after being properly stored in the plant for a period of 120 days.

All the above tests are to be conducted in accordance with the specifications of the American Water Works Association for powdered activated carbon.

(Name of Firm)

*Signed by:*__________(Authorized Agent)

(Notarized)

Fig. 1. Recommended Forms of Certificate of Guarantee

Part B—Sampling, Inspection, Packing and Marking

Sec. 1B—Scope

These procedures for the sampling, inspection, packing, weighing and marking of powdered activated carbon are intended for use in connection with Part A (Material Specifications) and Part C (Testing Methods) of this document.

Sec. 2B—Cautions

See Sec. 2A.

Sec. 3B—Sampling

3B.1. Samples shall be taken at the point of destination.

3B.2. If the powdered activated carbon is handled by conveyor or elevator, or shipped in bulk, a mechanical sampling arrangement may be used.

3B.3. If the material is packaged, 5 per cent of the packages shall be sampled. No sample shall be taken from a broken package. If the packaged material is shipped in carload lots, one package from each lot number may be selected for sampling, with a minimum of 20 bags being sampled per carload.

3B.4. Powdered activated carbon may be sampled, by the use of a sampling tube which is at least ¾ in. in diameter, from carload shipments in bulk or from packages.

3B.5. The gross sample, weighing 2 to 5 lb., shall be mixed thoroughly and quartered to provide three ½-lb. samples. These shall be sealed in airtight, moistureproof glass containers. Each sample container shall be labeled to identify it and the label shall be signed by the sampler.

Sec. 4B—Packing and Shipping

4B.1. Powdered activated carbon shall be packaged in dustproof containers (multiwall paper bags are recommended) containing from 35 to 150 lb. each.

4B.2. When paper bags are used in shipments of less than carload lots, they shall be protected by an outer package of a resistant nature in order to avoid tearing the bags. Complete protection from weather shall be provided for the individual packages or by the conveyance.

4B.3. The net weight of the packages shall not deviate from the recorded weight by more than 5.0 per cent, plus or minus. If exception is taken to the weight of the material received, it shall be based on a certified unit weight of not less than 10 per cent of the packages shipped, selected at random from the entire shipment.

4B.4. For shipments of activated carbon in bulk, the type of freight car or hopper car shall be agreed upon by the supplier and the user prior to shipment. The important factor is the type of handling equipment and unloading facilities at the destination. If exception is taken to the weight of the material as received, the consignee shall have the privilege of having each car and contents reweighed on certified railroad scales at the destination by the delivering carrier prior to unloading. This certified weight shall be considered as the basis for payment, except when there is definite proof of loss or damage to the shipment while in transit.

Sec. 5B—Marking

Each shipment of material shall carry with it some means of identification. Each package shall have marked legibly thereon the net weight of the contents, the name of the manufacturer and a brand name, if any. The package may bear also the statement "Guar-

anteed by (name of manufacturer) to meet the specifications of the American Water Works Association for powdered activated carbon." If lot numbers are used, they shall be marked on each bag near either end so that they will be visible when the material is piled for storage.

Part C—Testing Methods

Sec. 1C—Scope

These methods for the examination of powdered activated carbon are intended for use in connection with Part A (Material Specifications) and Part B (Sampling, Inspection, Packing and Marking) of this document.

Sec. 2C—Sampling

2C.1. Sampling shall be conducted in accordance with Part B (Sampling, Inspection, Packing and Marking) of this document.

2C.2. The sample delivered to the laboratory shall be quartered to approximately 100 g. After thorough mixing, this sample should be stored in an air-tight glass container and weighed out of it rapidly to avoid change in moisture content.

2C.3. The laboratory examination of the sample shall be completed within five working days after receipt of the shipment.

Sec. 3C—Moisture

3C.1. *Procedure.* Weigh exactly, in a tared weighing bottle, approximately 1.0 g. of the sample and place in a drying oven for four hours at 140°C.; then cool in a desiccator and weigh rapidly.

3C.2—*Calculation:*

$$\frac{\text{Loss of weight}}{\text{Weight of sample}} \times 100 = \text{per cent moisture}$$

Sec. 4C—Apparent Density

4C.1. *Definition.* The apparent density of a carbon is the weight in grams of 1 ml. of the carbon in air.

4C.2.—*Procedure:*

4C.2.1. Weigh a 10-g. sample of the carbon to be tested.

4C.2.2. Carefully transfer one-third of the weighed sample to a 50- or 100-ml. cylindrical graduate, and, while gently tamping on a rubber pad or stopper, keep adding more carbon until the entire sample is transferred.

4C.2.3. Tamp for five minutes and then continue to tamp for two-minute periods until there is no further settling produced by a two-minute period of tamping; note the volume of the settled carbon.

4C.3—*Calculation:*

$$\frac{\text{Weight of sample}}{\text{Volume of sample}} = \text{weight per ml.}$$

Weight per ml. $\times$ 62.4 = lb./cu.ft.

Sec. 5C—Fineness

The wet-screen method shall be used for determining the percentage of carbon retained on the screens of 100-mesh, 200-mesh and 325-mesh size.

5C.1—*Procedure:*

5C.1.1. Weigh accurately about 10 g. (if 8-in. screens are available, 100 g. may be used) of the carbon and place in a tared vessel.

5C.1.2. Place in a drying oven at 140°C. for four hours, cool in a desiccator and then weigh again as rapidly as possible to prevent moisture absorption. This procedure determines the loss by drying and gives a record of the moisture content of the carbon (if desirable, the first determination of moisture may be omitted and this figure recorded).

5C.1.3. Place the weighed dry sample into a beaker and add 600–700 ml. of water; wet the carbon thoroughly; then stack the screens with the 100-mesh screen on top. First wet the screens thoroughly and slowly pour the mixture of carbon and water on the screens, taking care not to plug them. It is well to mix the carbon and the water once or twice while pouring. Wash all the carbon from the beaker.

5C.1.4. After all the carbon has been deposited on the screens, wash with a small stream of water until it is believed that no carbon continues to pass through the screens.

5C.1.5. Separate the screens and place the 100-mesh screen over a large white porcelain dish, and collect in this the water passing the screen. If additional carbon continues to pass, it can readily be seen against the white surface. Wash the carbon which passes the 100-mesh screen and is collected in the porcelain dish onto the 200-mesh screen. Wash the carbon on the 200-mesh screen with a small stream of water in the same manner as for the 100-mesh screen until practically no carbon is observed in the water collected in the porcelain dish. Continue in the same manner, using a 325-mesh screen.

5C.1.6. By means of a stream from a small hose, transfer the carbon remaining on each screen into separate beakers, and transfer the carbon in each beaker into separately tared Gooch crucibles fitted with a fine asbestos mat.

5C.1.7. Dry the crucibles and carbon in an oven at 140°C. as in Sec. 5C.1.2. Cool them in a desiccator for one hour and weigh them. The net weight of carbon in each crucible is then recorded. The per cent of carbon of each size is calculated from the formula:

5C.2—*Calculation:*

$$\frac{\text{Net weight of carbon in each crucible}}{\text{Dry weight of original sample}} \times 100$$
$$= \text{per cent carbon retained of each size}$$

NOTE: The amount of carbon retained on the 325-mesh screen, plus the amount retained on the 200-mesh screen, plus the amount retained on the 100-mesh screen, gives the total that would have been retained on the 325-mesh screen. Report results as per cent passing 100-mesh, per cent passing 200-mesh, and per cent passing 325-mesh screens. Whenever possible, a 325-mesh screen should be used. With small screens, it is possible to conduct all drying and weighing operations directly on the screens. When 3-in.-diameter screens are used, a 2-g. portion of carbon is sufficient.

Sec. 6C—Phenol Adsorption

6C.1. *Stock phenol solution.* 1 g. of pure phenol, C_6H_5OH, is dissolved in distilled water and the solution made up to 1,000 ml., so that 1 ml. of solution contains 1 mg. of phenol. Standardize with bromate-bromide reagent. After two weeks this solution should be discarded and a new solution prepared.

The bromate-bromide reagent may be prepared by adding a definite amount of bromate to a bromide solution, which, on acidification, will liberate a definite amount of bromine according to the reaction:

$$KBrO_3 + 5KBr + 6HCl \rightarrow 3Br_2 + 6KCl + 3H_2O$$

$$3Br_2 + C_6H_5OH \rightarrow C_6H_2Br_3OH + 3HBr$$

The acid is added only to the portion of the reagent used for the test. In preparing a 0.1*N* solution, 2.784 g. of pure potassium bromate and 10 g. of potassium bromide are dissolved in a little distilled water and diluted to 1,000 ml. To 50 ml. of the stock phenol

solution, equivalent to 0.05 g. of phenol, is added (in a glass-stoppered bottle) 50 ml. of bromate-bromide solution and the mixture shaken. 5 ml. of concentrated hydrochloric acid is added, the solution is again shaken and, after fifteen minutes, 2 g. of potassium iodide is added. The liberated iodine is titrated in the presence of starch solution with $0.1N$ sodium thiosulfate. A blank determination is made and the necessary correction is applied. 1 ml. $0.1N$ $Na_2S_2O_3 \cdot 5H_2O$ equals 1.5685 mg. C_6H_5OH.

6C.2. *Standard phenol solution.* Dilute 2 ml. of stock phenol solution, prepared and standardized as directed in Sec. 6C.1, to 2,000 ml. in a certified volumetric flask with phenol and chlorine-free distilled water (*see below,* Sec. 6C3).

6C.3. *Phenol and chlorine-free distilled water.* To provide distilled water free from phenol, add 10–20 ppm. of activated carbon and let stand overnight. Before using, filter, with the aid of a vacuum pump, through a filtering mat in a Buchner funnel prepared according to the procedure outlined in Sec. 6C.14 below. Test for residual chlorine and, if chlorine is present, expose to sunlight for several hours or boil in an open vessel until the test for residual chlorine is negative.

6C.4. *Preparation of phenol standards.* Prepare standards containing 0, 5, 10, 15, 20, 25, 30, 35, 40, 50, 60, 70, 80, 90 and 100 ppb. (parts per billion) C_6H_5OH. To make these standards, measure from a certified buret 0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0 and 10 ml. of standard phenol solution (Sec. 6C.2), respectively, into 100-ml. matched Nessler tubes which have been previously marked.

6C.5. *Paper pulp stock suspension.* With the aid of stirring equipment, beat 25 g. of filter paper (Whatman No. 2, No. 5 or No. 42 filter paper, or equivalent) with 500 ml. of distilled water until thoroughly disintegrated into a fine pulp consistency. A working pulp suspension is made by diluting 100 ml. of the stock suspension with 1,000 ml. of distilled water and stirring at 800–900 rpm. for ten minutes or longer. 20 ml. of this suspension is equivalent to 0.1 g. of dry pulp.

6C.6. *Preparation of phenol solutions for adsorption test.* Measure with a 100-ml. certified volumetric flask, or pipet, 100 ml. of standard phenol solution prepared as directed in Sec. 6C.2. (NOTE: This is not *stock* phenol solution.) Dilute to 1,000 ml. in a certified 1-liter volumetric flask with phenol-free distilled water, the pH of which is approximately 7.0 and the temperature 20–25°C., and transfer to suitable beakers and jars. Twelve such samples should be prepared, six of which are used at a time. When the test is carried on in duplicate, the second set should be stirred while the first set is being filtered. (*See below,* Sec. 6C.15.)

6C.7. Set aside a 2,000-ml. portion of the distilled water to be carbon treated, to which no phenol has been added. (*See below,* Sec. 6C.12.)

6C.8. Place six of the samples prepared as described in Sec. 6C.6 on the stirrer and stir for five minutes at 100–300 rpm.

6C.9. *Carbon stock suspension.* Weigh out exactly 1.000 g. of activated carbon as received and make up to 1,000 ml. with phenol-free distilled water. 1 ml. of this suspension contains 1 mg. of carbon and is equivalent to 1 ppm. when added to 1,000 ml. of water.

6C.10. Stir the carbon suspension continuously at 100–300 rpm. while making the carbon additions to the samples.

6C.11. *Carbon dosage.* For carbons having a phenol value ranging from 15 to 25, the carbon dosages suggested are 5.0, 7.5, 10.0, 12.5, 15.0, 17.5 and 20.0 ppm., which may be obtained by adding, respectively, 5.0, 7.5, 10.0, 12.5, 15.0, 17.5 and 20.0 ml. of the carbon suspension (as described in Sec. 6C.9) per 1,000 ml. used. It is suggested that the 5.0-ppm. concentration be omitted if the phenol value is believed to be higher than 20, and that the 20-ppm. concentration be omitted if the phenol value is believed to be below 20. Also, some laboratories omit the lowest carbon dosage, that is, the 5.0 or 7.5 ppm., and alternatively use a blank containing no carbon or one portion containing 15 ppm. of the reference carbon. For carbons having a phenol value ranging from 25 to 35, the carbon dosages suggested are 10, 15, 20, 25, 30 and 35 ppm., obtained by adding, respectively, 10.0, 15.0, 20.0, 25.0, 30.0 and 35.0 ml. of the carbon suspension as above. (NOTE: Discharge pipet back into suspension after each addition, to avoid error. Allow five-minute intervals between each addition. This provides ample time for filtration, permitting the use of a single Buchner funnel.)

6C.12. To the 2,000-ml. diluting water and blank portion add 20 ml. of carbon suspension and place on stirrer, at approximately 100–300 rpm.

6C.13. The samples are all stirred at a uniform speed for one hour with the mechanical stirrer at 100–300 rpm. as above.

6C.14. *Preparation of the Buchner funnel for filtration.* Fit a 9-cm. Buchner funnel into a suction flask and connect to a laboratory vacuum pump. Place one Whatman No. 2, No. 5, or No. 42 filter paper (or equal) in the funnel. Apply suction and add 250 ml. of distilled water to which has been added 20 ml. of pulp suspension equivalent to 0.1 g. dry pulp, prepared as directed in Sec. 6C.5. Filter dry and discard filtrate.

6C.15. When the first sample has had exactly one hour of mixing and adsorption, remove from stirrer and place the duplicate check sample in its place. Add the proper amount of carbon suspension. Follow this same procedure as the successive samples are removed. The diluting water and blank should be removed at the end of one hour and filtered as directed in Sec. 6C.16 below.

6C.16. *Filtering treated samples.* Pour 250 ml. into the empty Buchner funnel prepared as described in Sec. 6C.14, with suction applied, and when the funnel has emptied, remove the flask and discard contents. A second 250-ml. portion is allowed to filter completely and is preserved in a suitable flask for test purposes—100 ml. of this filtrate will be used as a sample. Prepare a new filter for each sample and follow the same filtration procedure until all the samples are ready for test.

6C.17. *Dilution of standards.* After the first six samples and diluting water have been filtered, there is ample time to dilute the standards (prepared as directed in Sec. 6C.4) to the 100-ml. mark with the carbon-treated distilled water (prepared as described in Sec. 6C.7).

6C.18. When all the samples and duplicates have been filtered according to the procedure outlined above, and the standards have been prepared and diluted, the specific phenol determination selected should be made. Color

development of standards and samples must take place in the dark.

Sec. 7C—Method Using Diazotized Sulfanilic Acid as Indicator

7C.1—*Reagents:*

(a) *Stock and standard phenol solutions,* prepared as described in Sec. 6C.1 and 6C.2

(b) *Sulfuric acid solution*—25 per cent by volume of 1.84 sp.gr. sulfuric acid

NOTE: Special care must be taken to measure these quantities accurately, since the final mixture must have a pH of about 11.5 and excess quantities would destroy this adjustment.

(c) *Sodium nitrite solution* ($NaNO_2$)—weigh out 1.2 g. and make up to 250 ml. with distilled water

NOTE: This solution must be prepared fresh, and, since it is hygroscopic, desiccated material should be used.

(d) *Recrystallized sulfanilic acid*—weigh out 1.91 g. and make up to 250 ml. with distilled water

(e) *Diazotized sulfanilic acid*—prepare one-half hour before using, by acidifying 150 ml. of sulfanilic acid [Sec. 7C.1(d)] with 30 ml. of 25 per cent sulfuric acid [Sec. 7C.1(b)]; add with a swirling motion, a few milliliters at a time, 150 ml. of sodium nitrite solution [Sec. 7C.1(c)]; this mixture is then packed in cracked ice for one-half hour before using (cooled to between 0 and 10°C.)

NOTE: This makes enough diazotized sulfanilic acid for 30 Nessler tubes. The above ratio must be maintained in modifying quantities prepared.

(f) *8 per cent sodium hydroxide solution*—8.0 g. of sodium hydroxide and 92 ml. of distilled water are required for approximately 100 ml. of solution

7C.2—*Procedure:*

7C.2.1. Add 10 ml. of the diazotized sulfanilic acid to each sample prepared as directed in Sec. 6C.16, and to each standard prepared as directed in Sec. 6C.4 and diluted as indicated in Sec. 6C.17.

7C.2.2. Add to each sample and standard as noted above 5 ml. of 8 per cent sodium hydroxide.

7C.2.3. After 30 minutes' standing, the colors have reached a maximum and can be read against a white background. In addition to direct reading of Nessler tubes by eye, colorimeters, filter photometers and spectrophotometers are available for use in colorimetric estimations.

Sec. 8C—Method Using 2,6 Dibromoquinonechlorimide as Indicator

8C.1—*Reagents:*

(a) *Stock and standard phenol solutions,* prepared as described in Sec. 6C.1 and 6C.2

(b) *Alkaline sodium borate solutions*—dissolve 15 g. of anhydrous sodium tetraborate powder in 900 ml. of warm distilled water; stir vigorously while the powder is being added, to avoid lumping; add 3.27 g. of sodium hydroxide in the form of a strong solution (20–40 per cent) and make up to 1,000 ml. with distilled water; 5 ml. of the buffer solution when added to 100 ml. of distilled water should produce a pH of 9.6; if the pH produced varies more than 0.1 pH, the proper adjustment of the buffer reagents should be made

(c) *Standard buffer solutions*—for the pH range 8.8–10.0, these are made according to Clark and Lubs,* using 50

* In *The Determination of Hydrogen Ions* by W. Mansfield Clark (2nd ed., 1925), p. 107.

ml. 0.2*M* H_3BO_3 : 0.2*M* KCl and the amount of 0.2*M* NaOH shown below:

pH	0.2*M* NaOH *ml.*
8.8	16.40
9.0	21.40
9.2	26.70
9.4	32.00
9.6	36.85
9.8	40.80
10.0	43.90

Dilute each of the above mixtures to 200 ml.

(d) *Thymolphthalein indicator*—dissolve 0.1 g. of indicator in 250 ml. of 85–90 per cent ethyl alcohol; use 0.5 ml. of indicator solution to 10 ml. of buffer solution tested

NOTE: The pH electrometer equipped with a glass electrode is the most accurate method for determining the pH values required in Sec. 8C.2.2. For laboratories where such equipment is not available, it is recommended that the standard solutions described above [Sec. 8C.1(c), (d)] be used.

(e) *Dibromoquinonechlorimide indicator* (either solution can be used):

(1) Dissolve 0.1 g. of indicator in 25 ml. of 95 per cent ethyl alcohol and place in a small glass-stoppered brown bottle; this stock solution will keep three or four days in a cool dark place; to use, dilute 5 ml. of the stock solution to 100 ml. with distilled water in a brown bottle (*this solution is decomposed rapidly by sunlight*); if fresh indicator is desired for each phenol adsorption test, dissolve 0.02 g. of indicator in 5 ml. of 95 per cent ethyl alcohol in a 100–125 ml. glass-stoppered brown bottle; dilute to 100 ml. with distilled water just before using.

(2) An aqueous solution may be made by grinding 0.04 g. of indicator in a mortar with 10 ml. of distilled water until the indicator is completely dispersed; wash into a brown glass-stoppered bottle and dilute to approximately 100 ml.; shake ten minutes and filter through filter paper (this solution decomposes very rapidly and *should not be used after 20 minutes*).

(f) *Copper sulfate solution*—dissolve 0.050 g. $CuSO_4 \cdot 5H_2O$ per 1,000 ml.

8C.2—*Procedure:*

8C.2.1. Add to the samples and to the standards 1 ml. of copper sulfate. (This may be omitted only when it is known that no traces of copper and tin are present.)

8C.2.2. Add to each sample and standard 5 ml. of alkaline sodium borate solution, unless previous experience has proved that greater amounts are necessary to produce a pH of 9.6 ± 0.1.

8C.2.3. Add to each sample and standard 1.5 ml. of the aqueous-alcoholic solution of 2,6 dibromoquinonechlorimide indicator [Sec. 8C.1(e)(1)] or 2 ml. of aqueous solution prepared as directed [Sec. 8C.1(e)(2)]. During development of color, the tubes containing the samples and standards should be stored in a dark place.

8C.2.4. Color comparisons can be made against a white background after four hours' standing, but preferably after standing overnight. (Reference is made to a previous A.W.W.A. Committee Report * for notes on details of the methods of testing, which contain precautions developed by the original investigators.)

Sec. 9C—Plotting and Reporting Results

9C.1. Plot the results on double-logarithmic paper (Keuffel & Esser

* Specifications and Tests for Powdered Activated Carbon. Final Report of Subcommittee. Jour. A.W.W.A., **30**:1168 (1938).

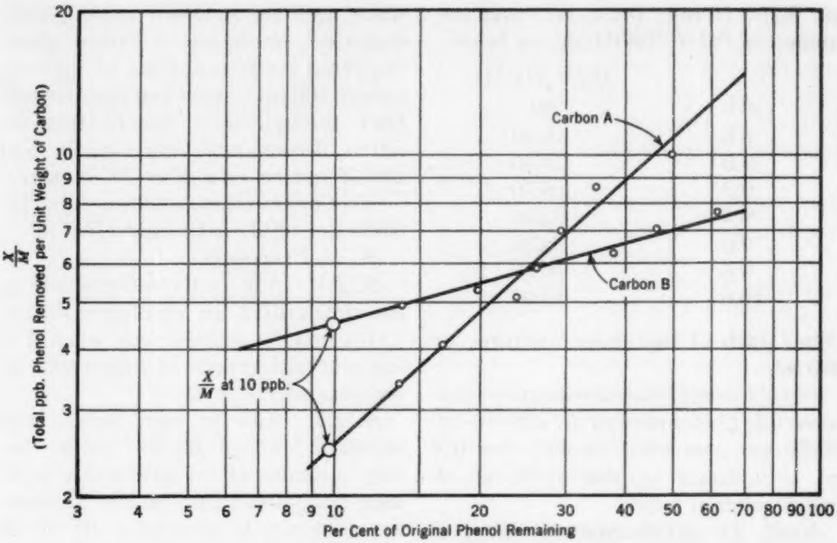


Fig. 2. Illustration of Plotting and Reporting Results (Phenol Value)

Freundlich Adsorption Equation: $\frac{X}{M} = KC^{1/n}$

X = total amount of phenol adsorbed, ppb. C_6H_5OH
M = amount of activated carbon used, ppm. carbon
C = residual concentration of phenol, ppb. C_6H_5OH at dosage M

Test No.: 101
Date: May 6, 1938
Carbon sample: A and B
Observer: M.M.B.

Phenol solution (distilled H_2O)
Original concentration: 100 ppb.
Solution Temp.: 23.8°C.
Contact Time: 1 hour

Carbon A

Carbon Dosage *ppm.*	Residual Phenol C_6H_5OH *ppb.*	$\frac{X}{M}$ Value
5.0	62.0	7.6
7.5	47.0	7.0
10.0	38.0	6.2
12.5	26.5	5.8
15.0	20.0	5.3
17.5	14.0	4.9
	10.0	4.5*

Phenol value: (20.0)

Carbon B

Carbon Dosage *ppm.*	Residual Phenol C_6H_5OH *ppb.*	$\frac{X}{M}$ Value
5.0	50.0	10.0
7.5	35.0	8.6
10.0	30.0	7.0
15.0	24.0	5.1
20.0	17.0	4.1
25.0	14.0	3.4
	10.0	2.5*

Phenol value: (36.0)

Calculation

Carbon A

At 10-ppb. phenol residual:

$$\frac{X}{M} = 4.5; \frac{90}{M} = 4.5$$

M = 20.0 (phenol value)

Carbon B

At 10-ppb. phenol residual:

$$\frac{X}{M} = 2.5; \frac{90}{M} = 2.5$$

M = 36.0 (phenol value)

* Extrapolated.

No. 358–110 2 × 2 cycles, or equal) to establish the relationship between the carbon dosage, the total amount of phenol removed and the amount of phenol remaining for each sample of the above series. By plotting the total amount of phenol removed per unit weight of carbon at each carbon dosage as the ordinate, and the corresponding amount of the per cent of original phenol remaining as the abscissa, a straight-line plot is obtained if the experimental data are correct. In plotting of the line between points, the so-called method of "least squares" shall be used to establish the correct position of the line. (*See* Fig. 2.)

9C.2. The phenol value of the carbon is obtained from the plot by extrapolating the adsorption value of the carbon (the total amount of phenol removed per unit weight of carbon) corresponding to the 10-ppb. phenol residual (90 per cent removal), and dividing it into the total amount of phenol removed (90 ppb. C_6H_5OH). This computed value gives the amount of carbon, expressed in parts per million, required to reduce the standard phenol concentration of 100 ppb. to 10 ppb. phenol, and is known as the "phenol value" of the carbon, as shown in the example plot (Fig. 2).

9C.3. Because of the slight experimental errors and the limited accuracy of the phenol test technique, the values will seldom fall exactly on a straight line. Therefore, an average of duplicate tests made on each sample which checked within ± 10 per cent shall be considered the phenol value of the carbon sample. This value shall be computed to "dry basis" from the per cent moisture found (*see* Sec. 3C).

9C.4. By the expression "± 10 per cent" is meant that a carbon offered for sale as having a phenol value of 20 may, upon test, be found to have a phenol value of 18 (20 minus 10 per cent) or 22 (20 plus 10 per cent) without premium or penalty becoming applicable.

Sec. 10C—Threshold Odor in Evaluating Carbons

10C.1. The threshold odor values of water treated by known and unknown carbons shall be obtained using the method given in *Standard Methods for the Examination of Water and Sewage* (9th ed., p. 16). When two operators are available, the alternate procedure for examining water samples should be used, as given in *Standard Methods* (p. 18). Most laboratories use 30 per cent increments between dilutions; but, when possible, and especially if the odor of the raw water is low, 15 per cent increments must be used in testing carbon. This test is valuable in comparing unknown carbons and in comparing shipments of carbon with the original reference sample.

10C.2. *Apparatus.* The apparatus consists of five carbon filter tube funnels, 38 mm. id., similar to Fisher Scientific Cat. No. 8–260; a supply of glass wool Fiberglas No. 219; five 500-ml. open-mouth Erlenmeyer flasks; and a laboratory stirring or mixing apparatus, equipped to mix at least four samples. The stirrers should be of glass—a $\frac{3}{16}$-in. glass rod of sufficient length, with a $1\frac{1}{2}$-in. bend at a 45-deg. angle to the shaft, answers the purpose ideally. A stirring speed with a peripheral velocity equal to the mixing velocity experienced at the plant should be used. A 2,000-ml. jar is preferable to a 1,000-ml., since it permits larger pipetting volumes of the carbon suspensions and, hence, adds to the accuracy of the test.

10C.3. *Reagent—carbon stock suspension.* Weigh 1.0 g. of activated car-

bon (as received) and make up to 1,000 ml. with odor-free water. 1 ml. of this suspension contains 1 mg. of carbon and is equivalent to a dosage of 1.0 ppm. when added to 1,000 ml. of water to be treated.

10C.4—*Procedure:*

10C.4.1. Place about 4 g. of glass wool in one filter funnel for each carbon being tested and press firmly into place. Place funnels in separate Erlenmeyer flasks. Wash the glass wool with odor-free water until the filtrate is odor-free.

If, in plant practice, it is beneficial or customary to add other chemicals to the water at the same time that the carbon is applied, these chemicals, in amounts equivalent to those used in plant practice, should be added to the sample under examination at the same time that the carbon is added.

10C.4.2. Preliminary trials will be required to determine the range in which to apply the carbon. Generally speaking, a threshold of not over 15 requires between 2 and 8 ppm. of carbon, with corresponding increases for higher threshold values. The treatment applied must be such that an appreciable odor remains in the treated water. The volume of each sample should be 1,000 ml. While the stock carbon suspension is being measured into the sample, it should be stirred continuously at 200–300 rpm.

10C.4.3. The stirring time of the samples themselves or the contact time of the carbon should be identical for all samples of carbon being evaluated. If the time of contact of the carbon with the water in plant practice can be determined, this is a good contact period to choose. Otherwise, a one-hour contact period is suggested. At the end of the contact period, the samples must be filtered quickly, after which the threshold values can be obtained and conclusions drawn.

10C.4.4. The variation in the price of carbons should be taken into account in making the comparison. For instance, if one carbon costs 5¢ a pound and another 2.5¢ a pound, only half as much 5¢ as 2.5¢ carbon should be used in determining their relative effectiveness in odor removal.

These "Tentative Standard Specifications for Powdered Activated Carbon" were prepared under the direction of C. K. Calvert (deceased) and J. E. Kerslake of the Water Purification Division, A.W.W.A. The specifications were approved by the Executive Committee of the Water Purification Division and by the Water Works Practice Committee, and received the approval of the Association's Board of Directors on July 11, 1949. The specifications were also submitted for review to producers and consumers of the materials involved, whose comments were then considered by Oscar Gullans, acting as referee. The text as finally edited was approved by the Executive Committee of the Water Purification Division on July 7, 1950.

NEW YORK

Herald Tribune

DECEMBER 23

Carney Resigns Water Post at Mayor's Order

Quits by Letter After He Receives Telephone Call Request From Sampson

By Leonard Ingalls

Stephen J. Carney, Commissioner of Water Supply, Gas & Electricity, submitted his resignation by request yesterday to Mayor Vincent R. Impellitteri, effective at the Mayor's pleasure—which Mr. Impellitteri said would be Tuesday.

As regular Democratic district leader of the 17th Assembly District, Brooklyn, Mr. Carney supported the Democratic candidate for Mayor, Ferdinand Pecora, in the recent Mayoralty election against Mr. Impellitteri, who ran as an insurgent Democrat.

In his letter of resignation Mr. Carney disclosed the method that is being used by Mr. Impellitteri and his supporters to obtain the resignations of city officials inherited from the administration of former Mayor William O'Dwyer, and clear the way for the appointment of persons who backed Mr. Impellitteri for election.

The request for the resignation from his $15,000-a-year commissionership, said Mr. Carney, did not come directly from the Mayor, but by telephone from Frank Sampson, assistant to the Mayor and a Manhattan Democratic district leader who bolted the organization to help manage Mr. Impellitteri's insurgent campaign.

"Dear Mr. Mayor," Mr. Carney wrote, in resigning, "Frank Sampson phoned me to say that you desired my resignation. He explained that while you felt my work as Commissioner was satisfactory there were certain political commitments which you had to fulfill. Accordingly, I am submitting my resignation, to take effect at your pleasure."

Mr. Carney delivered his letter of resignation to the Mayor's office in person. Mr. Impellitteri acknowledged it in a one-sentence written reply, making Tuesday the effective date.

Mr. Impellitteri would not discuss his choice to succeed Mr. Carney, other than to say: "I am considering somebody for the post." The "somebody," it was learned, is Dominick F. Paduano, Mr. Carney's assistant as First Deputy Commissioner of Water Supply, Gas and Electricity at $9,000 a year. Mr. Paduano was active in the Mayoralty campaign for Mr. Impellitter.

Mr. Impellitteri's only comment on Mr. Carney's letter was: "I feel that as Mayor I have the right to select my own cabinet."

Asked if he had requested any other resignations from top officials, Mr. Impellitteri replied: "Not at the moment, but there undoubtedly will be others."

Mr. Carney, who was appointed July 9, 1948, by former Mayor O'Dwyer, was the second commissioner to offer his resignation to Mr. Impellitteri since the latter's election as Mayor. The first was Fire Commissioner Frank J. Quayle.

Mr. Impellitteri is scheduled to make a number of appointments Wednesday at City Hall at which time it is expected that Mr. Paduano will be sworn in as commissioner of water supply. Mr. Paduano received his first appointment as a deputy commissioner of water supply from former Mayor O'Dwyer.

NO COMMENT

DECEMBER 27

Mayor Naming Paduano Head Of Water Dept.

Carney Successor and 7 Other Officials Will Be Sworn In at Noon Today

By Walter Lister Jr.

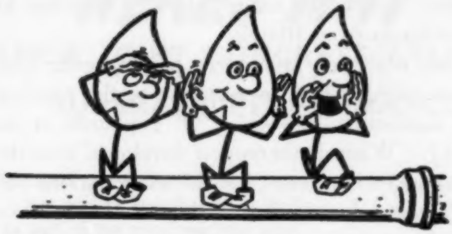
Mayor Vincent R. Impellitteri will swear in two new city commissioners, three deputy commissioners and three city magistrates at noon today in City Hall. The five administrative posts were recently vacated by men who actively opposed Mr. Impellitteri's election.

Dominick F. Paduano will become Commissioner of Water Supply, Gas and Electricity at $15,000 a year, and George P. Monaghan, as previously announced, will become Fire Commissioner at the same annual salary.

Sydney S. Baron, a Republican, will assume the $9,000-a-year post of Deputy Commissioner of Marine and Aviation; Americus Delli Paoli will receive the same salary as Deputy Commissioner of Hospitals; and Frederick S. Weaver will become Deputy Commissioner of Housing and Buildings at $8,000 a year.

The three new magistrates, at $12,000 a year, will be Anthony Maglio, legal assistant to Mr. Impellitteri; Louis Pagnucco, an Assistant District Attorney in Manhattan; and Charles Solomon, a former magistrate under the late Mayor F. H. LaGuardia.

Mr. Paduano, forty-nine, has been first deputy in the water department. He replaces Stephen J. Carney who resigned as commissioner at the request of the Mayor last Friday. Both Mr. Carney and



Percolation and Runoff

The A.W.W.A. Board of Directors' meeting, held last month in the univory tower of New York's Park-Sheraton Hotel, has been reported formally in the Association's January 31st letter "To all members." But anyone who knows any of the principals involved will be certain that all was not as dull, dismal and deliberate as thereby indicated. Work was done of course—as a matter of fact, work just short of enough to make forty "boys" dull—but who could be really dull in the glare of one of Wendell LaDue's neckcries, dismal in the face of Harry Shaw's lugubriety, or deliberate to the tune of "Dixie" Lordley's rebel rousing?

It was mostly during mealtimes that such hair as was available was let down. Then it was that Bill Orchard took over Vic Weir's gavel and called the meeting to disorder, presiding over such traditional pocket-pickers as the "quarter toss"—an indirect means of flipping coins into someone else's pocket—and the "attendance pool"—an exercise in unrestrained optimism which is never lucrative. This year the law of averages was apparently tilted in the direction of Minnesota, for it was the Morrises —lady first—who took home all the quarters from two bitter two-bitters. Since they must wait to make a clean sweep until the formalities of a 71st Annual Conference are out of the way, however, it remained for Florida's Dave Lee and Doc Black to provide the excitement of "the pool" with descriptions of Miami's attractions which again demonstrated just who it was that put "florid" into the state's name. Awarded ornate back scratchers for successfully shifting emphasis from the itchy palm to the itch for palms, Messrs. Black and Lee were also roundly thanked for the virtual grove of Temple oranges and tremendous grapefruit which proved to us that these, too, of Florida's attractions were good to squeeze.

At the meetings, meanwhile, "Morris" Cunningham was able to demonstrate clearly why Oklahoma could not be described as, or even accused of, "outlying Texas." And in the evening, Fred Merryfield more than lived up to the first part of his name in appreciating "South Pacific." But

(*Continued on page 4*)

(*Continued from page 3*)

what the directors will probably remember longest is the exercise in numerology provided by the gentleman from Illinois.

Already driven in distraction from any attempt at playing golf, Cliff Fore began a new siege of name-calling when, in response to the opening roll call, he gave his hotel room number as "4–4–O" ("O" explained as his roommate, Mel Hatcher of MO.). When it thereupon developed that the year-end membership of the Illinois Section was "4–4–4," imaginations ran riot and it could have been Cliff who pointed out that this was evidence of his having completed his job as director—his term ending in 1951. If so, pity poor Helge Five, Sr. Park Engr. of the Long Island State Park Com., whose New York Section at year's end reported the significant total of "6–6–6."

And speaking of the New York Section, it was to its annual luncheon meeting that the Board adjourned on Tuesday 1–1–6–5–1.

Big sleeps from little catnaps grow. So, at least, it seems when one small snooze can virtually paralyze a town of 15,000—shutting down an International Harvester plant of 3,200 workers, closing all schools and making life miserable for every housewife. The explanation, obviously, is "water" and the redoubtable drowser involved, one John Essex of Canton, Ill., whose function it is, as night watchman of the water system, to shut off the pumping plant intake valve "when the system is full." Thus, when, on the night of January 7, John had a few too many winks, water flooded the basement, submerged the pumps and knocked the system out completely.

One result of his fateful slumber has been to make John the best known man in town and, undoubtedly, the best known night watchman in the country. (What, he'd like to know, did Rip Van Winkle's or Humphrey Bogart's "Big Sleep" have that his didn't?) But another result we'd like to predict is an automatic shutoff to make one man's sleep less of a nightmare for everyone else.

(*Continued on page 6*)

(Continued from page 4)

"Just Add Water" is fast becoming the new cook's tour de force. What started out innocently enough as a means of making a bouillon cube edible has by now inundated almost the entire kitchen. Want a home-made cake, biscuits, rolls? Just add water! Have some soup, some pudding, some pie? Just add water! Like some fresh orange juice, grapefruit juice, apple juice? Just add water! And now they've gone and done it to milk, making of it not that powdered military flotsam, but a nice rich goo with which added water actually blends. What if our gastronomical gears grind a little protest—who are we to complain when water is our business and our business is thus bound to boom?

Forget your stomach for the moment, then, and think of business. Think of how convincing the evidence will be that your product really is not only *a* necessity, but *the* necessity of life. Why, when people realize that you are doing three times as much as the cow to produce their milk, they're bound to show a new kind of appreciation. Just give the powers of concentration enough time to expand into other fields than food and your public will soon begin to realize that it's the "O" in H_2O that's the most important part of the stuff they breathe. First thing you know everybody will understand that water is everything. And you, with power over everything, may even be able to sell the stuff for as much as seven cents a ton.

Bring your stomach into the discussion, though, and you may get indigestion. After all, when you begin to provide 75 per cent of the bulk of any food, you're bound to exercise some control over its taste. And if the algae one day get the jump on you, and little Johnnie won't drink his orange juice, it will most certainly be your fault that he caught a cold. Where the taste of a supply just naturally doesn't harmonize with the concentrate, dairymen have already discovered that the water taste can be masked by the addition of chocolate in the process, but who wants chocolate milk on strawberries? And what's to prevent your being sued for restraint of trade?

For that indigestion, by the way, you might try a bromo. Pour the powder into a glass and. . . .

Too much means not enough at Novato, Calif., where continued heavy winter rainstorms have prevented work on the community's new reservoir. That it's a good wind which blows no one some ill must be evident from the fact that this untimely flood is going to force water rationing in Novato again next summer. As a matter of fact, with its reservoirs at 95.6 per cent of capacity on January 18, New York City may be in somewhat the same predicament as far as not being able to find room to store this winter's bounty against next summer's tax.

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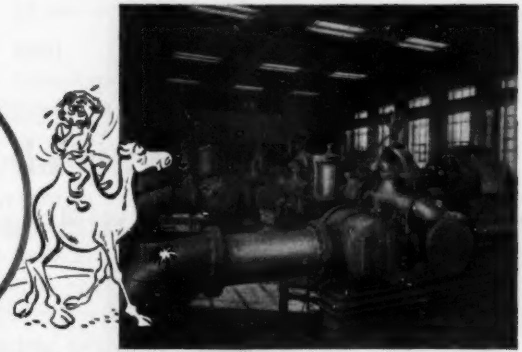

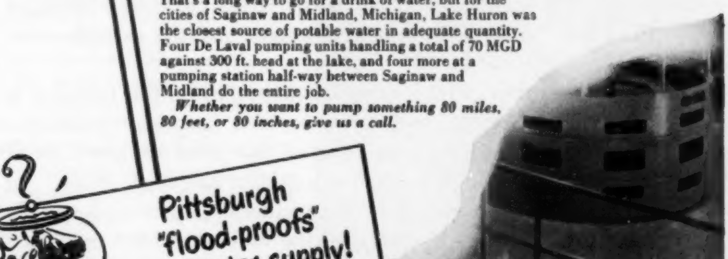

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John G. Stewart

Dorothy E. Dimmers

John G. Stewart has been appointed manager of the Water & Sewage Works Manufacturers Assn., succeeding the late Arthur T. Clark. A graduate of Princeton University, he spent several years in the financial field and was head of a Wall St. firm. During World War II he served in the Navy, and for the past four years was in the sales and promotion department of the Hotels Statler Co., Inc.

Dorothy E. Dimmers, who has been Acting Secretary-Manager since the death of Mr. Clark, was appointed secretary of the association.

Lawrence Farber, whose name has appeared on the JOURNAL's masthead as associate editor for the past three years, has been recalled to active service with the Army. Captain Farber has been assigned to duty in Japan, where he saw service in the last war as a language officer. In addition to editing the manuscripts of the technical papers and specifications published in the JOURNAL, he compiled the indexes, edited the "Condensation" section and performed a host of other duties which the rest of the staff is now beginning—to its sorrow—to find out about.

Arthur B. Morrill has returned to his home in Detroit after three years in China, during which he acted as consulting sanitary engineer for the World Health Organization (WHO). A veteran of the Orient, in which he had previously served under U.S. Public Health Service auspices, he treats his last tour of duty in Shanghai—half of which was spent under communist control—as just another assignment, and plans to spend several months at home while on leave, pending new orders.

(*Continued on page 10*)

(Continued from page 8)

The microfilm edition of the JOURNAL is at last a reality. The 1949 volume—all 2,336 pages of it—is now available on a reel of microfilm which, with its container, occupies about as much space as two packs of cigarettes. The film, which produces a clear and easily read image when used with any reader giving an elargement of 19 times or more, is available to A.W.W.A. members and JOURNAL subscribers from University Microfilms, 313 N. First St., Ann Arbor, Mich. Cost for the volume is $6.15. It is expected that greatest usefulness of the film edition is to be obtained after the paper edition has been subjected to the first year's maximum use—and wear and tear. Substituting the microfilm after such an interval usually means that no inconvenience is suffered by requiring the use of the film reader for frequent reference to current issues, that the waste of large volumes of storage space is avoided, and that the vexation of torn, misplaced or missing issues is neatly sidetracked.

Gilbert R. Frith, formerly public health engineer with the Georgia Dept. of Public Health, has been assigned to duty at Third Army headquarters, in the rank of lieutenant colonel. He will serve as sanitary engineer with the Third Army Medical Section at Fort McPherson, Ga.

(Continued on page 14)


HERSEY
WATER METERS
stand higher than ever in popularity among experienced Water Works Officials. Today these meters are more widely used than ever before . . . The basic engineering design of Hersey Water Meters has never been equaled.
That is the Reason
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SOUTH BOSTON, MASS.

STRENGTH is vital

Be doubly sure when you specify pipe for mains to be laid under city pavements. Sure that it effectively resists corrosion. Sure, also, that it has the four strength factors, listed opposite, that pipe must have to withstand beam stresses, external loads, traffic shocks and severe working pressures. *No pipe, deficient in any of these strength factors, should ever be laid in paved streets of cities, towns or villages.* Cast iron water and gas mains, laid over a century ago, are serving in the streets of more than 30 cities in North America. These attested service records prove that cast iron pipe not only assures you of effective resistance to corrosion but all of the vital strength factors of long life and economy.

CAST IRON PIPE

(*Continued from page 10*)

Examinations for certification in Ohio as water or sewage treatment operator in grades A, B and C are to be held on April 27 in five cities. Applications to be filed before March 17 may be obtained from the Advisory Board of Examiners, Ohio Dept. of Health, 301 Ohio Departments Bldg., Columbus 15, Ohio.

First things come first with the National Automatic Sprinkler and Fire Control Association. At any rate, in its brochure on "The Automatic Sprinkler System, An Invaluable Auxiliary to Water Utilities, Municipalities and the Public," it features a three-line red-letter slogan on the cover:

SAVES WATER
SAVES LIVES
SAVES MONEY

All is not lost!

Evans L. Shuff & Assoc. has been appointed Atlanta, Ga., representative for Graver Water Conditioning Co. Headquarters of the organization are at 303 Five Ivy Bldg., Atlanta 3.

(*Continued on page 16*)

(*Continued from page 14*)

Fish stories, as such, shouldn't concern us. Of course, there usually is water around somewhere, but it isn't often of the essence—and we do try not to stretch the theme too far. But when a female member of a university faculty lands a 21-in. 3½-lb. bass with one rock at 20 ft., that's news that even the water works man ought to hear about.

The characteristically impatient fisherwoman involved is Miss Jean Murphy of Boston University, who was fishing in a Plymouth pond when she saw her victim frisking about some 20 ft. offshore. A little displeased at not having had a bite, Miss Murphy hove a rock. Beaned, the bass paddled sluggishly toward shore, where Miss Murphy waded out some 5 ft. to greet it.

Unless there is more female fibbery or Irish imagination in this tale than the *United Press* usually dispatches, Miss Murphy's classes must be extraordinarily orderly; and unless mobilization is for some reason halted soon, Miss Murphy may well be pitching for the New York Yankees next season.

It must have been Jean's mother who was famous for her chowder. And could it have been Jean who threw. . . ?

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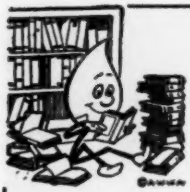


The Reading Meter

Water in Industry. *National Assn. of Manufacturers, 14 W. 49th St., New York 20, N.Y., and the Conservation Foundation, 30 E. 40th St., New York 16, N.Y. (1950) no charge.*

Through text, graphs and tables, this 51-page fact-crammed booklet presents the water-use practices of over 3,000 industrial plants surveyed during 1950 as a joint project of the NAM Committee on Conservation of Renewable Natural Resources and the Conservation Foundation. Information is provided on the sources and quantity of water used, types of use and treatment, methods of disposal and local degree of pollution, with summaries by metropolitan and regional areas. The plants surveyed produce 21 classes of products and represent all geographic areas of the country.

The need for the new concrete data offered is neatly illustrated by the wide diversity of opinion among industrialists who, as a part of the survey, were asked about the potentialities for greater use of water in their areas. To answer this and other equally significant questions, more and more of the type of data published in this booklet will have to be compiled and disseminated. Copies are being mailed to all A.W.W.A. members; others interested may obtain theirs by request to the Conservation Foundation.

The Engineering Method. *John Charles Lounsbury Fish. Stanford Univ. Press, Stanford, Calif. (1950) $3.*

This stimulating volume offers a study of the manner in which engineering decisions are reached, and thus makes explicit, not only the most valuable tool the engineer can apply to the solution of new or unusual problems, but also a logical procedure which can well be applied to the determination of routine problems in economics, politics and matters of personal choice. The lesson is brought home to water supply workers particularly because of the use, as an illustration of the method in action, of the selection of the Hetch Hetchy supply for San Francisco by John R. Freeman in 1912. The method is universal, however, and it is possible that even engineers might learn to use it more universally, and profitably.

(Continued on page 20)

The Reading Meter

(*Continued from page 18*)

Western Land and Water Use. *Mont H. Saunderson. University of Oklahoma Press, Norman, Okla. (1950) $3.75.*

Another conservation-conscious author reviews the need for intelligence and constructive action in the use of the most basic—and critical—resources of the West. It is interesting to note how frequently and emphatically experts on this topic recommend placing greater reliance on proper land and watershed use than on costly dams and engineering works.

The history of confusion, neglect and destructive greed which have brought this country's resources—particularly in the West—to the verge of bankruptcy is all too familiar, and measure after measure has been taken to stop the drain and provide a remedy. So much still remains to be done, however, that this book, or any of the saner of its many fellows, is must reading for any good citizen, particularly if he be a public official concerned with water supply.

N.F.P.A. Inspection Manual. *Horatio Bond, ed. National Fire Protection Assn., 60 Batterymarch St., Boston 10, Mass. (1950) $3.*

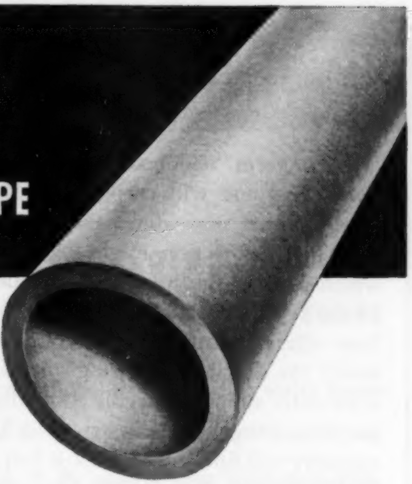
This pocket-size manual supersedes the out-of-print *Field Practice* of N.F.P.A. which has been in use since 1914. Methods of conducting inspections for fire prevention and maintenance are outlined for the benefit of fire departments, insurance agencies, engineers and others, including property owners themselves. Chapters on water supplies cover private supplies, sprinkler equipment, tanks, pumps and other matters of interest to the water utility superintendent.

Handbook of Chemistry. *Norbert Adolph Lange and Gordon M. Forker, ed. Handbook Publishers, Inc., Sandusky, Ohio (7th ed., 1949) $7.*

Keeping pace with the rapid advance of scientific knowledge is difficult enough even for the specialist, but for the compiler of a handbook it becomes a career in itself. This volume, having run through seven editions since its first publication in 1934, offers a list of two dozen revised, and fourteen new tables since the last edition in 1946. Among the revised material are tables giving typical analyses of public water supplies, and tables of water viscosity.

(*Continued on page 22*)

The inside story of "Century"® ASBESTOS-CEMENT PIPE



BEFORE you specify pipe for water mains, be sure to consider the *inside*, as well as the outside. Here's what you'll find inside "Century" Asbestos-Cement Pipe:

A SMOOTH, CLEAN BORE THAT STAYS THAT WAY!—"Century" Asbestos-Cement Pipe is formed on a smooth, steel mandrel—the pipe's interior takes its surface from this . . . permanently smooth! (Williams and Hazen Constant "C" is conservatively placed at 140 for "Century" Asbestos-Cement Pipe).

A NON-TUBERCULATING SURFACE! Tuberculation, one of the pipe enemies from within, first increases friction, then reduces flow area. This cannot happen with "Century" Asbestos-Cement Pipe. It is entirely non-metallic. Initial flow capacity remains constant!

A SURFACE THAT RESISTS CORROSION! Though corrosion is usually an *external* enemy of pipe, certain combinations of water chemicals, together with electrolysis, can bring about internal pipe corrosion and deterioration. "Century" Asbestos-Cement Pipe is entirely mineral in nature—is immune to electrolysis—resists all corrosion factors, both internal and external!

Installation crew laying "Century" Pipe through wooded area.

AND CONSIDER THE OTHER FEATURES OF "CENTURY" ASBESTOS-CEMENT PIPE: "Century" Pipe is exceptionally strong, yet, light in weight. It can be handled easily, laid quickly, without special laying equipment. The "Century" Simplex Couplings are of the same Asbestos and Cement composition as the pipe—permit rapid, easy laying of both straight runs and curves up to 5° deflection per pipe length. And, so permanently strong and unchanging is "Century" Pipe, that it can be recovered and laid in its original pressure class!

BEFORE YOU BUY OR SPECIFY ANY PIPE FOR WATER MAINS, get the complete story on Keasbey & Mattison "Century" Asbestos-Cement Pipe. We'll gladly send details upon request.

Nature made Asbestos . . .

Keasbey & Mattison has made it serve mankind since 1873

K&M best in asbestos ®

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

The Reading Meter

(Continued from page 20)

Civil Engineering Handbook. *Leonard Church Urquhart, ed. McGraw-Hill Book Co., New York (3rd ed., 1950) $8.50.*

The term "handbook" having come to mean "a massive, unwieldy tome," no one will carp at the somewhat more handy—although hardly pocket size—dimensions of this latest addition to the reference shelf. An objection might be voiced to the use of coated paper, which adds to the weight of a volume in which few illustrations are of the type that require this sort of handling, but on the whole the book offers an attractive presentation of the mass of data which come under the "civil engineering" heading. Terse, cogent sections deal with water supply from collection, through purification, to distribution, but it is on the matters not specifically in his field that the water works engineer will find the book most helpful. On such subjects as surveying, mechanics of materials, hydraulics, steel design, cement and concrete, stresses in framed structures, and foundations, he will be able to refresh his memory and advance his knowledge of basic theory, standards, practice and data.

Membership Changes

NEW MEMBERS

Applications received December 1 to 31, 1950

Allen, Cletus, *see* Winter Haven (Fla.)

Amick, Yancey Leroy, Supt., Water Works, Cayce, S. C. (Jan. '51) *MP*

Ashworth, William H., Salesman, Hays Manufacturing Co., 612 University Dr., Greensboro, N.C. (Jan. '51) *M*

Barr, Norman Lewis Jr., Sales Repr., Keasbey & Mattison Co., 338 Esperson Bldg., Houston 2, Tex. (Jan. '51)

Baskous, Athan A., Asst. San. Engr., Bureau of Environmental San., State Office Bldg., Albany, N.Y. (Jan. '51) *P*

Baughman, Howard S., Supt., Board of Public Affairs, 304½ E. Main St., Versailles, Ohio (Jan. '51)

Binkley, Thad C., Mgr., Associated Engineers, Inc., 3606 El Camino Real, Palo Alto, Calif. (Jan. '51) *MR*

Borchelt, C. T., Parner, Austin Engineering Co., Inc. 115 S. Jefferson, Peoria, Ill. (Jan. '51) *PR*

Cowsert, E. L., Mgr., West Helena Water Co., West Helena, Ark. (Jan. '51) *M*

Culbreath, Mark C., Prin. Engr., Burns & McDonnell Engineering Co., 7119 Grand Ave., Kansas City 5, Mo. (Jan. '51)

Deakin, Donald Forest, Mgr., Water & Sewer Products, The Atlas Mineral Products Co., Mertztown, Pa. (Jan. '51) *M*

DeLand, City of, A. B. Sylvia, Supt., Water Works & Sewage, City Hall, DeLand, Fla. (Mun. Sv. Sub. Jan. '51) *MPR*

Delp, Loren A., Chemist, Water Dept., West End Plant, Topeka, Kan. (Jan. '51)

Enid, City of, L. M. Wells, Chief Engr., Water Plant, 1424 W. Chestnut, Enid, Okla. (Corp. M. Jan. '51) *MPR*

Forsyth, Edgerton Dennis, Town Engr., Box 345, Hearst, Ont. (Jan. '51)

Fournelle, Harold J., San. Bacteriologist, Arctic Health Research Center, U.S. Public Health Service, Box 960, Anchorage, Alaska (Jan. '51)

Gale, Alvin Burton, Supt. of Maint., San Diego County Water Authority, 314 Land Title Bldg., San Diego 1, Calif. (Jan. '51) *M*

Gallaher, Charles W., City Engr., City Hall, Lawton, Okla. (Jan. '51)

Gore, Daniel Jack, Mgr., Public Works Com., Fayetteville, N.C. (Jan. '51) *M*

Graves, Quintin B., *see* Oklahoma A. & M. College Treatment Plant

Greenlees, Jack Urban, Sales Engr., Rensselaer Valve Co., 254 Spring St., N.W., Atlanta, Ga. (Jan. '51)

Grivich, John Andrew, Asst. Supt., Water Dept., Arcadia, Calif. (Jan. '51)

Guiry, Raymond M., Mgr., The Kennedy Valve Manufacturing Co., 1306-12 So. Canal St., Chicago 7, Ill. (Jan. '51)

Hammond, Arthur T., *see* Montpelier Munic. Water Works

Harper, Curtis T., Sales, Stauffer Chemical Co., Box 68, North Portland, Ore. (Jan. '51) *P*

Hicks, C. L., Water Supt., North Asheboro Branch, North Asheboro Central Falls San. Dist., North Asheboro, N.C. (Oct. '50) *M*

Hinson, Ben A., Salesman, Neptune Meter Co., 254 Spring St., N.W., Atlanta, Ga. (Jan. '51)

Hinson, Robert Dowling, Eng. Aide, Water Dept., Pensacola, Fla. (Jan. '51) *M*

Holland, David C., Salesman, General Chemical Div., Allied Chemical & Dye Corp., 234 Hurt Bldg., Atlanta 3, Ga. (Jan. '51) *P*

Houston, J. Leek, Salesman, Cities Supply Co., Box 4122, Charlotte, N.C. (Oct. '50) *M*

Ionics, Inc., William E. Katz, Chemical Engr., 152—6th St., Cambridge 42, Mass. (Corp. M. Jan. '51) *PR*

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Johnson, William Martin, Partner, Wiley & Wilson, Cons. Engrs., 305 Peoples National Bank Bldg., Lynchburg, Va. (Jan. '51) *MPR*

Katz, William E., *see* Ionics, Inc.

King, Charles, Owner, King Eng. Co., 214 Clay St., Kingsport, Tenn. (Jan. '51) *P*

King, Howard E., San. Officer, Board of Health, City Hall, Fort Wayne, Ind. (Jan. '51)

Lanning, Augustus James, Cons. Engr., 709 Schiller Ave., Trenton 10, N.J. (Oct. '50) *MP*

Lee, Joe F., Supt., Water Works, Umatilla, Fla. (Jan. '51) *M*

LeMay, Andrew L., Water Supt., Oroville, Wash. (Jan. '51) *M*

Lewis, Douglas D., Dist. Engr., Surface Water Branch, U.S. Geological Survey, 510 Rudge-Guenzel Bldg., Lincoln 8, Neb. (Jan. '51) *R*

Libbey, Whitney R., Supervisor, Filtration Plant, Winthrop-Stearns Inc., 33 Riverside Ave., Rensselaer, N.Y. (Jan. '51) *MP*

Lynch, James Gillinder, Field Instructor, Eng. Extension Service, Indistrial Div., Texas A & M College System, Box 236 F.E., College Station, Tex. (Jan. '51) *P*

Mathis, Alice L., (Miss), Chemist, Water Dept. & Sewage Treatment, Phoenix, Ariz. (Jan. '51) *MP*

McMurray, Curtis W., Supt., Del Este Water Co., 726—10th St., Modesto, Calif. (Jan. '51)

Metzger, James Edward, Director, Dept. of Public Utilities, 900 E. Broad St., Richmond 19, Va. (Jan. '51)

Miller, Leonard William, Sales Repr., American Cyanamid Co., 20 N. Wacker Dr., Chicago 6, Ill. (Jan. '51) *P*

Minear, I. G., City Clerk, Canton, Kan. (Jan. '51) *MR*

Montpelier Munic. Water Works, Arthur T. Hammond, Supt., Montpelier, Ind., (Corp. M. Jan. '51)

Neate, Francis Eric, Jr. Asst. Engr., Water Works Dept., City Hall, Victoria, B.C. (Jan. '51) *M*

Oklahoma A. & M. College Treatment Plant, Quintin B. Graves, Supt., Stillwater, Okla. (Corp. M. Jan. '51) *P*

Olsen, Richard F., Office Mgr., Del Este Water Co., 726—10th St., Modesto, Calif. (Jan. '51) *M*

Oltman, Roy E., Hydr. Engr., U.S. Geological Survey, 510 Rudge-Guenzel Bldg., Lincoln 8, Neb. (Jan. '51) *R*

Ostlie, Edwin H., Chief Operator, Water Treatment Plant, 420 S. 3rd St., Grand Forks, N.D. (Jan. '51) *P*

Redfern, Calvin E., Salesman, Hersey Mfg. Co., 4431 S.E. 50th, Portland 6, Ore. (Jan. '51)

Roop, William Curtis, Jr. Civil Engr., Dept. of Water Supply, 735 Randolph St., Detroit 22, Mich. (Affil. M. Jan. '51) *M*

Smith, Robert E., Chief San. Engr., Capitol Eng. Corp., Dillsburg, Pa. (Jan. '51) *P*

Smith, Tom M., Gen Mgr., Modern Electric Water Co., 904 N. Pines Rd., Opportunity, Wash. (Jan. '51) *M*

Speed, Carleton S., Supt., Water Works, New Smryna Beach, Fla. (Jan. '51)

Staben, M. E., *see* Staben & Hooper & Assocs.

Staben & Hooper & Assocs., M. E. Staben, Partner, 222 Market St , Waukegan, Ill (Corp. M. Jan. '51) *PR*

Stauffacher, E. R., Elec. Engr., Southern California Edison Co., Box 351, Los Angeles 53, Calif. (Jan. '51)

Stead, John E., Pres. Indian Head Water Co., Inc., 102 S. Monroe St., Tallahassee, Fla. (Jan. '51) *M*

Steelman, Milton, Jr., Mgr., Lakewood Water Co., 257—2nd St., Lakewood, N.J. (Jan. '51) *M*

Stewart, John G., Mgr., Water & Sewage Works Mfrs. Assn., Inc., 170 Broadway, New York 7, N.Y. (Jan. '51)

Straeffer, Charlie, Sales Repr., Diehl Pump & Supply Co., 500 S.E. 8th St., Evansville, Ind. (Jan. '51)

Storey, Roger William, Asst. Mgr., Water Works Board, City Hall, Montgomery, Ala. (Jan. '51) *M*

Sullivan, Michael John, Agricultural Chemist, Arizona Fertilizers, Inc., Box 2828, Phoenix, Ariz. (Jan. '51)

Sylvia, A. B., *see* DeLand (Fla.)

Vanlaningham, Rollie, Supt., Light & Water Dept., St. Francis, Kan. (Jan. '51) *M*

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(*Continued from page 32*)

Vondrick, Arthur F., Asst. San. Engr., Cook County Dept. of Public Health, 737 S. Wolcott St., Chicago, Ill. (Jan. '51) *MP*

von Oesen, Henry, Owner, Loughlin & von Oesen, Cons. Engrs., Wilmington, N.C. (Oct. '50) *P*

Watson, F. R., Mayor, Box 205, Elaine, Ark. (Jan. '51) *M*

Wells, L. M., *see* Enid (Okla.)

Wellington, Harold F., Asst. Hydr. Engr., Public Service Com., 233 Broadway, New York 7, N.Y. (Jan. '51) *M*

White, Wayne Elwood, Supervisor of Fluorine Research & Development, Ozark-Mahoning Co., Box 449, Tulsa, Okla. (Jan. '51) *PR*

Winter Haven, City of, Cletus Allen, City Mgr., Winter Haven, Fla. (Corp. M. Jan. '51) *MP*

Woods, Charles E., Rate Clerk, New Haven Water Co., 100 Crown St., New Haven, Conn. (Jr. M. Jan. '51) *M*

Yarrington, John, Supt., Water Dept., Monroeville, Ind. (Jan. '51) *MP*

Yee, Phillip K. H., Deputy Engr. & Supt., Suburban Water System, City Hall, Honolulu, Hawaii (Jan. '51) *M*

REINSTATEMENT

Helms, Perry H., Com. of Public Works, Myrtle Beach, S.C. (Oct. '42)

Nason, Edward McKinney, Dist. Engr., Dist. No. 2, Dept. of National Health & Welfare, Public Health Eng. Div., R.R. 1, Moncton, N.B. (Apr. '49)

Rocca, Agostino, Chairman of Techint, Compania Tecnica Internacional, Sarmiento 335, Buenos Aires, Argentina (Sep. '31)

Smith, Neal D., City Mgr., Santa Cruz, Calif. (July '40)

LOSSES

DEATHS

Meyer, H. R. J., Sr. Civ. Engr., Supply & Purif. Section, Water Div., 4545 Alice Ave., St. Louis 15, Mo. (Jan. '25) *P*

Tufts, William, Partner, Hutchins & Tufts, Rm. 836 Park Square Bldg., Boston, Mass. (July '47) *R*

CHANGES IN ADDRESS

December 5, 1950 to January 5, 1951

Acevedo Quintana, F., Carmen a Mamey, Edificio El Carmen, Apartamento No. 1, Caracas, Venezuela (Jan. '41)

Adams, W. W., *see* Builders-Providence, Inc.

Allen, James H., Chief Engr., Interstate Com. on Delaware River Basin, 341 Broad St., Station Bldg., Philadelphia, Pa. (Jan. '43)

Bandy W. A., 4604 Placid Pl. Austin, Tex. (July '44)

Bannan, M. W., *see* New Britain (Conn.) Water Board

Barr, J. J., Vice Pres., Water Utilities Service Corp., 121 S. Broad St., Philadelphia 7, Pa. (Jan. '44)

Barrus, Ben M., Box 3482, Orlando, Fla. (Jan. '49)

Barton, Harry, 606 Mansfield Dr., Fairlawn, N.J. (Dec. '28)

Baumann, Edward Robert, 310 Hessel Blvd., Champaign, Ill. (Jan. '47)

Belleville, Laurier, Supervising Engr., National Health & Welfare, Room 1, 1162 St. Antoine St., Montreal, Que. (Jan. '49)

Benedict, Paul C., Regional Engr., U.S. Geological Survey, Water Resources Div., Lincoln, Neb. (Jan. '49)

Benjes, Henry H., 5417 Brooklyn, Kansas City 4, Mo. (Jan. '50)

Bennett, A. L., Public Health Engr., State Health Dept., Box 149, Washington, Iowa (Oct. '49)

Billings, L. C., Supervisor & Chief Chemist, Water Treatment, Dallas 1, Tex. (May '23)

Blundon, J. Paul, Snyder & Small, Cons. Engrs., 112 N. Davis St., Keyser, W. Va. (Apr. '30)

Bosch, Felipe, Chief, Operations Div., Puerto Rico Aqueduct & Sewer Authority, Box 2832, San Juan 12, Puerto Rico (Jan. '50)

Bradlee, Warren R., 12 Ferris Dr., Old Greenwich, Conn. (Apr. '47)

Brooks, R. W., Dist. Mgr., Layne Western Co. 721 Illinois Ave., Aurora, Ill. (Oct. '46)

(*Continued on page 36*)

HAYS

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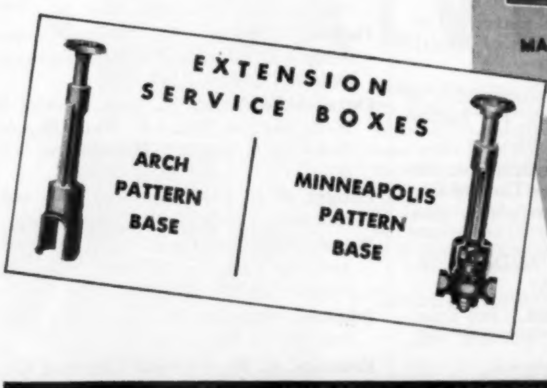

HAYS MANUFACTURING COMPANY

12TH & LIBERTY STREETS, ERIE, PENNA., U. S. A.

(*Continued from page 34*)

Brown, Eugene, Instructor of Chemistry, Univ. of Florida, Gainesville, Fla. (Jan. '49)

Bryan, Harry D., Sales Engr., Ludlow Valve Mfg. Co., 2415 San Jacinto, Houston 4, Tex. (July '47)

Builders-Providence, Inc., W. W. Adams, Asst. Sales Mgr., 345 Harris Ave., Providence 1, R.I. (Assoc. M. June '01)

Bukk, Eugene C., *see* Jamestown (Ind.)

Bunnell, E. F., Mgr., Idaho Water Co., 319 Main St., Box 636, Kellogg, Idaho (Jan. '47)

Burnham, Lyle M., Sales Engr., Western Utilities Supply Co., 3875 Mahrt Ave., Salem, Ore. (Oct. '40)

Cameron, City of, L. W. Smith, Supt., Box 570, Cameron, Tex. (Corp. M. Jan. '46)

Carbide & Carbon Chemicals Div., Union Carbide & Carbon Corp., Plant K-25 Library WCX A-15704, Box P, Oak Ridge, Tenn. (Corp. M. Jan. '49)

Carter, Earl E., Supt., Water & Sewer Depts., City Hall, 4152 W. Broadway, Robbinsdale 22, Minn. (Jan. '46)

Carter, H. E., Box 640, Tempe, Ariz. (July '35)

Charbonneau, Thomas, 1649 Longwood Rd., Apartment D, Jacksonville, Fla. (Jan. '45)

Chase, Douglas E., 441 Perry Highway, West View, Pittsburgh 29, Pa. (Jan. '43)

Childs, Fred S., 69 New Brier Lane, Allwood, Clifton, N.J. (May '30)

Clarkson, Arthur W., Asst. Director, Div. of San. Eng., State Board of Health, Helena, Mont. (Oct. '50)

Clifford, Robert K., Commonwealth of Virginia, Div. of Budget, 117 Ballard St., Richmond 19, Va. (Oct. '49)

Cockrell, Alton P., Chief Operator, Birmingham Industrial Water Co., 405 City Hall Bldg., Birmingham 3, Ala. (Jan. '47)

Colburn, B. S., Jr., 542 McDowell St., Asheville, N.C. (July '46)

Collins, Lindsay Mathewson, Civil Engr., c/o MacCormack, 20 Harvard Rd., Linden, N.J. (Jan. '50)

Cook, Leland B., Cons. Engr., Box 290, Tupelo, Miss. (Jan. '47)

Couch, Lawrence I., Cons. Engr., 230 E, Ohio St., Room 218, Indianapolis 4. Ind. (Jan. '44) *P*

Cowden, Burney B., 46 Trowbridge, Cambridge 38, Mass. (Jan. '48)

Cowser, Kenneth, San. Engr., State Dept. of Health, 807½ S. Neil St., Champaign, Ill. (Jr. M. Jan. '49)

Craig, Stanley R., 604-C Pinecrest Circle, Marietta, Ga. (July '46) *MP*

Crete, City of, George R. Miller, Light, Water & Sewer Com., 243 E. 13th St., Crete, Neb. (Corp. M. July '46)

Critchlow, H. T., Directory & Chief Engr., Div. of Water Policy & Supply, State Dept. of Conservation, 520 E. State St., Trenton 9, N.J. (Feb. '30) *Fuller Award* '48. *R*

Crockett, J. L., Jr., Asst. San. Engr., State Dept. of Health, 537 Dexter Ave., Montgomery, Ala. (Apr. '47) *P*

Cross Water Co., A. V. Handorf, Jr., 14702 E. Clark Ave., Puente, Calif. (Corp. M. Jan. '49)

Crutchfield C. C., *see* League of Texas Municipalities

Dearborn Chemical Co., J. G. Surchek, Asst. Mgr. NO-OX-ID Sales, 310 S. Michigan Ave., Chicago 4, Ill. (Assoc. M. June '27)

Dennett, Robert Clark, 155 N. Columbus Ave., Freeport, N.Y. (May '14)

Doan, L. A., *see* Great Western Div.

Doyle, William H., Asst. San. Engr., State Board of Health, 1035 N. 22nd St., Milwaukee 3, Wis. (Apr. '42)

DuBois, Francis W., DuBois-Cooper Assocs., 15760 James Couzens Highway, Detroit 21, Mich. (Jan. '38)

Duvauchelle, Henry N., Supt., Service & Meter Section, Board of Water Supply Box 3410, Honolulu 1, Hawaii (Jan. '47) *M*

Ebright, H. L., 6353 Miles Ave., Box 486, Huntington Park, Calif. (July '41)

Eckart, Nelson A., Cons. Engr., 11—15th Ave., San Francisco 18, Calif. (Mar. '30) *Director '36-'39. MR*

Edelblut, Walter J., Jr., Engr., Box 2054, Fort Myers, Fla. (Jan. '49)

Erickson, E. T., Erickson Chemical Co., 333 N. Michigan Ave., Chicago 1, Ill. (Jan. '45) *P*

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Erickson, Erick V., Chief Plant Engr., Light & Water Plant, Lakeland, Fla. (Oct. '48) *MP*

Erie County Water Authority, John Horner, Chairman, 390 Ellicot Sq. Bldg., Buffalo 3, N.Y. (Corp. M. July '49)

Estes, John M., Water Dept., 375 S. Euclid Ave., Upland, Calif. (Oct. '49)

Eugene Water & Electric Board, Walter Jacob Moore, Water Supt., 1116 Willamette St., Eugene, Ore. (Corp. M. Jan. '39) *Fuller Award '47. Director '47-'50. MP*

Fairview County Water Dist., 1884 Harbor Blvd., Costa Mesa, Calif. (Corp. M. Jan. '47)

Fall River Water Dept., Matthew D. Sullivan, Supt., 1620 Bedford St., Fall River, Mass. (Corp. M. Jan. '49)

Feiler, Alfred M., 10967 Roebling Ave., Los Angeles 24, Calif. (July '48)

Fisher, S. M., Dist. Mgr., San Gabriel Valley Water Co., 151 W. Spring St., Fontana, Calif. (Jan. '49)

Flood, T. S., Idaho Waterworks Corp., Box 1761, Boise, Idaho (Apr. '44)

Foreman, Charles S., Pres., C. S. Foreman Co., 1900 Armour Rd., North Kansas City 16, Mo. (June '20)

Frederickson, A. Anton, Pres. & Gen. Mgr., City Utilities Co., Pima, Ariz. (July '47)

Fulmer, Leu Relle, Jr., Sales Engr., R. D. Wood Co., 1600 Gaines St., Little Rock, Ark. (July '50)

Gearhart, John B., c/o City Engr., North Bend, Ore. (Apr. '48)

Gearhart, John C., Pacific States Cast Iron Pipe Co., 502 Spalding Bldg., Portland 4, Ore. (Jan. '39)

Geyer, John C., Prof. of San. Eng., Johns Hopkins Univ., Baltimore 18, Md. (Oct. '34)

Gilbert, M. D., Dist. Mgr., Rockwell Mfg. Co., Box 1807, Tulsa, Okla. (July '46)

Gillespie, Chester Gordon, 82 Natalie St., Los Gatos, Calif. (June '11)

Gloyna, Earnest F., San. Eng. Dept., Johns Hopkins University, Baltimore 18, Md. (Oct. '49)

Goode, Norman John, Dept. of Health, Parliament Bldgs., Victoria, B.C. (Jan. '47)

Gorman, Richard C., Jr., 269 Delaware Ave., Elsmere, Delmar, N.Y. (May '29)

Guernsey, C. H., C. H. Guernsey & Co., Cons. Engr., 2701 N. Oklahoma, Oklahoma City 2, Okla. (Oct. '46)

Great Western Div., Dow Chemical Co., L. A. Doan, Sales Mgr., 310 Sansome St., San Francisco, Calif. (Assoc. M. July '41)

Grossman, Irving, 1476 Main St., E., Rochester 9, N.Y. (Apr. '50)

Haase, Louis, 1618 Peck St., Muskegon Heights, Mich. (July '50)

Halff, Albert H., 4591 Rheims Pl., Dallas 5, Tex. (Apr. '49)

Hamilton, Robert A., Jr., Secy. & Supt. of Constr., R. A. Hamilton Corp., 409 S. River St., Hackensack, N.J. (July '49)

Hansen, Robert E., Supt., Filtration Plant & Pumping Station, Route 8, 36470 Jefferson, Mt. Clemens, Mich. (Jan. '47)

Hardison, Clayton H., Hydr. Engr., U.S. Geological Survey, 1612 Dayton Rd., Hyattsville, Md. (July '50)

Harmeson, Donald K., Director, Div. of San. Eng., State Board of Health, Dover, Del. (Apr. '50)

Harper, M. J., Dist. Mgr., Rockwell Mfg. Co., 7701 Empire State Bldg., New York 1, N.Y. (Jan. '49)

Harrell, H. O., Water & Sewage Supt., City Water Plant, El Reno, Okla. (Apr. '49)

Hayden, Richard, 5 Costello Rd., Verona, Pa. (July '41)

Herring, Thomas Francis, Vice-Pres., Sales & Service, Beckman Instruments, Inc., 820 Mission St., South Pasadena, Calif. (Jan. '49)

Heyward, Nathanial J., 4138 Mountwood Rd., Apartment 3-B, Baltimore 29, Md. (July '45)

Hoffman, Donald A., Alvarado Filtration Plant, 7100 Colorado Ave., San Diego 15, Calif. (July '49)

Hollowell, A. Cooley, Dist. Mgr., Badger Meter Mfg. Co., 827 Tauromee Ave., Kansas City 1, Kan. (Jan. '47)

Homack, Peter, San. Engr., Elson T. Killam, Cons. Engr., 529 Millburn Ave., Short Hills, N.J. (Jan. '48)

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HYDRO-TITE
(POWDER)
HYDRO-TITE
(LITTLEPIGS)
FIBREX
(REELS)

(*Continued from page 38*)

Horstmann, F. B., 6024 N. Navarre Ave., c/o L. F. Peterson, Chicago 31, Ill. (June '27)

Jacobson, Robert S., Box 5111, Capitol Station, Charleston, W. Va. (Affil. July '50)

Jamestown, Town of, Eugene C. Bukk, Water Works Supt., Jamestown, Ind. (Corp. M. Apr. '50)

Jefferson Chemical Co., Inc., Neches Plant, L. R. Strawn, Plant Mgr., Port Neches, Tex. (Corp. M. Jan. '48)

Jennings, Albert Edward, Vice-Pres., Munic. Utilities, 341 Church St., Toronto 2, Ont. (July '43)

Johnson, Robert F., *see* North St. Paul (Minn.) Public Utilities Com.

Jones, Ralph Lloyd, Culligan Soft Water Service, Inc., 101 S. Delaware Ave., Mason City, Iowa (Oct. '45)

Jones, William R., Chemist & Bacteriologist, Columbia Heights Filtration Plant, 45 Ave. N.E. & Reservoir Blvd., Minneapolis 13, Minn. (Affil. Jan. '41)

Jorgensen, Carl C., Supt., Water Dept., Box 58, Hayward, Calif. (Jan. '49)

Kerrville, City of, City Manager, City Hall, Kerrville, Tex. (Oct. '45)

Killam, Elson T., Hydr. & San. Engr., 529 Millburn Ave., Short Hills, N.J. (Dec. '31)

King, Carl H., City Engr., Box 613, Chinook, Mont. (Oct. '48)

League of Texas Municipalities, C. C. Crutchfield, Field Consultant, 108 E. 19th St., Austin 1, Tex. (Corp. M. '47)

Lewis, Fred Justin, School of Eng., Vanderbilt Univ., Nashville 4, Tenn. (Jan. '39)

Lockport Commission of Public Works, Albert G. Ward, City Engr., City Bldg., Lockport, N.Y. (Mun. Sv. Sub. Jan. '49)

Lowe, R. P., *see* Proportioneers, Inc.

Martin, Paul H., Repr., Neptune Meter Co., Station B., Route 1, Schirtzinger & Dublin Rd., Columbus, Ohio (Oct. '38)

Marzec, Edmund J., 1429 Virginia, Gary, Ind. (Jan. '36)

Mattson, H. B., *see* Preston Utilities Com.

McFarland, John W., Gen. Mgr., East Bay Munic. Util. Dist., 512—16th St., Oakland 4, Calif. (Oct. '49)

McHugh, B. M., Box 37, Enumclaw, Wash. (Jan. '49)

McIntosh, Russell W., West Coast Mgr., Protective Coating Div., Pittsburgh Coke & Chemical Co., 612 S. Flower St., Los Angeles 17, Calif. (Jan. '50)

Merrick, Clyde R., Water Supply Engr., Little Mountain, S.C. (Jan. '37)

Meyer, William George, Directory of Highways, City Street Dept., Fairmont, W. Va. (Jan. '47)

Miller, George R., *see* Crete (Neb.)

Mitchell, Louis, Eng. Bldg., Room 105, Eng. & Science Campus, Thompson Rd., East Syracuse 4, N.Y. (Mar. '32)

Monsanto Chemical Co., 1700 S. Second St., St. Louis 4, Mo. (Assoc. M. Apr. '37)

Moore, Walter Jacob, *see* Eugene (Ore.) Water & Electric Board

Municipal Utilities (Magazine), K. J. Salmond, Pres., 341 Church St., Toronto 2, Ont. (Assoc. M. May '16)

Myers, Charles A., Brunswick, Mo. (Jan. '50)

Naylor, George Wilson, Mgr., Vandergrift Div., Munic. Authority of Westmoreland County, 311 N. 2nd St., Apollo, Pa. (July '35)

Nebolsine, Ross, Pres., Hydrotechnic Corp., 665—5th Ave., New York 22, N.Y. (Jan. '46)

Nelson, Samuel B. S., Asst. Chief Engr. of Water Works, Dept. of Water & Power, 251 S. Larchmont Blvd., Los Angeles 4, Calif. (Oct. '34)

Ness, Robert O., Service Engr., Infilco, Inc., Box 5033, Tucson, Ariz. (Oct. '48)

New Britain Water Board, M. W. Bannan, Chairman, 27 W. Main St., New Britain, Conn. (Corp. M. Apr. '47)

Nickerson, Malcolm H., Factory Mutual Fire Insurance Co., 1919 Bank of Nova Scotia Bldg., 44 King St., Toronto 1, Ont. (Apr. '50)

Noice, W. Vincent, Culligan Soft Water Service, 221 Loveland, Gunnison, Colo. (July '48)

Northrup, B. J., Bacteriologist, Pinellas County Health Dept., Box 3242, St. Petersburg, Fla. (Jan. '49)

North St. Paul Public Utilities Com., Robert F. Johnson, Secy., North St Paul, Minn. (Corp. M. Apr. '46)

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Ogden, William H., 57 Glen St., Glen Cove, N.Y. (July '35)

Oliver, Burton L., B. L. Oliver & Co., 318 Grand Ave. Bank Bldg., Kansas City 8, Mo. (Apr. '48)

Ovington, James R., *see* Pomona (Calif.) Water Dept.

Paulette, Robert G., Infilco, Inc., 91 Central Sq., Pittsburgh 28, Pa. (July '46)

Pomona Water Dept., James R. Ovington, Mgr., City Hall, Pomona, Calif. (Corp. M. Oct. '43)

Porter, John F., Supt., Water Dept., 737 S.E. M Street, Grants Pass, Ore. (Jan. '49)

Preston Utilities Com., H. B. Mattson, Mgr., 506 King St., Preston, Ont. (Corp. M. Jan. '38)

Price, J. Paul, Engr., Box 670, Warren, Ohio (July '42)

Proportioneers, Inc., R. P. Lowe, Pres., 345 Harris Ave., Providence 1, R.I. (Assoc. M. Apr. '39)

Rast, F. S., Jr., Supt., Memphis Suburban Utility Dist., 1647 Frayson-Raleigh Rd., Memphis, Tenn. (Oct. '49)

Rice, Lawrence G., Cons. Civil Engr., 532 County Office Bldg., White Plains, N.Y. (Oct. '49)

Rich Manufacturing Co. of Calif., R. J. Ziegler, Sales Mgr., 3851 Santa Fe Ave., Los Angeles 58, Calif. (Assoc. M. Sept. '27)

Richard, Francis Philip, 309 Lagsrde St., Thibodaux, La. (Oct. '50)

Richmond, Maurice S., San. Engr., 400 Abbott Rd., East Lansing, Mich. (Jan. '49)

Roberts, H. G., Roberts & Brune Co., 1063 Old Country Rd., San Carlos, Calif. (Oct. '37)

Robinson, W. M., Secy.-Mgr., Water Dept., Box 870, Fort Worth, Tex. (Oct. '47)

Rock, Harold F., Dist. Engr., State Dept. of Health, Morris, N.Y. (Jan. '40)

Rohlich, Gerard Addison, Hydr. & San. Engr., Univ. of Wisconsin, Madison 6, Wis. (July '44)

Ross, A. W., Vice-Pres., Layne New York Co., 92 Liberty St., New York 6, N.Y. (Jan. '36)

Russell, J. P., Managing Editor, *Municipal Utilities*, 341 Church St., Toronto 2, Ont. (Jan. '34)

Salmond, K. J., *see Municipal Utilities*

Schramm, R. H., Branch Mgr., James B. Clow & Sons, 854 Leader Bldg., 526 Superior Ave. N.E., Cleveland 14, Ohio (July '40)

Seppe, Karl E., Div. Sales Engr., Armco Drainage & Metal Products, Route 1, Danville, Calif. (Oct. '50)

Shoup, Robert E., Supt., Water Works, Van Wert, Ohio (July '48)

Simcoe, N. W., Rockwell Manufacturing Co., Route 1, Wayzata, Minn. (Jan. '41)

Smith, L. W., *see* Cameron (Tex.)

Sohle, F. V., Sales Mgr., R. D. Wood Co., 6617 Snider Plaza, Dallas 2, Tex. (Oct. '42)

Strawn, L. R., *see* Jefferson Chemical Co., Inc.

Streander, Philip B., 497 Ridgewood Rd., Maplewood, N.J. (Dec. '23)

Sullivan, David N., 570 W. Stocker St., Glendale 2, Calif. (July '48)

Sullivan, Matthew D., *see* Fall River (Mass.) Water Dept.

Surchek, J. G., *see* Dearborn Chemical Co.

Thoman, John R., 9001 Seneca Lane, Bethesda 14, Md. (Jan. '41)

Thompson, N. J., Sales Repr., Dresser Mfg. Div., 2400 E. 13th Ave., Denver, Colo. (Oct. '39)

Tracy, R. N., Civil Engr., 234 Eudora St., Denver, Colo. (Jan. '35)

Turner, Clyde Milton, Headquarters Eng. Div., APO 403, c/o Postmaster, New York, N.Y. (July '47)

Ward, Albert G., *see* Lockport (N.Y.) Commission of Public Works

Ziegler, R. J., *see* Rich Manufacturing Co. of Calif.

Condensation

Key: In the reference to the publication in which the abstracted article appears, 39:473 (May '47) indicates volume 39, page 473, issue dated May 1947. If the publication is paged by the issue, 39:5:1 (May '47) indicates volume 39, number 5, page 1, issue dated May 1947. Abbreviations following an abstract indicate that it was taken, by permission, from one of the following periodicals: *B.H.—Bulletin of Hygiene (Great Britain); C.A.—Chemical Abstracts; Corr.—Corrosion; I.M.—Institute of Metals (Great Britain); P.H.E.A.—Public Health Engineering Abstracts; S.I.W.—Sewage and Industrial Wastes; W.P.R.—Water Pollution Research (Great Britain).*

ANNUAL REPORTS

Sacramento (Calif.) Div. of Water and Sewers. Annual Report (1949). Water sales \$874,861, operating expense \$394,892, bond interest \$88,944, net operating revenue \$391,025, nonoperating deficit \$5,800, net revenue \$385,224, bond redemption \$187,575, net profit \$197,650, capital expenditures \$90,215, net surplus \$107,435. Depn. \$187,651—no depn. sinking fund as provided for by city charter. Cost per mil.gal. \$61.91, consumer price \$70.58; per consumer \$19.84, consumer price \$22.62; per capita \$6.48 (consumer price). Purif. cost per mil.gal. \$7.55. Present value \$5,109,655. Avg. pumpage 34 mgd. (252 gpcd.), max. day 57.4 (425 gpcd.), max. rate 73.5. Ordinance creating division ('31) provides that if surplus in any yr. exceeds 25% of expenditures for operation, repairs and maintenance for preceding yr., excess may be transferred to city general fund. Entire supply from Sacramento R., coagulated, filtered and chlorinated. Mains 325 mi., valves 5573, hydrants 1993, flat-rate accounts 38.434, metered accounts (industrial) 241. Domestic meters prohibited by ordinance. Pop. 127,000, plus 8000 outside city. Terrain flat and distr. system operated as single zone—3 elevated tanks, 3-mil.gal capac. each, float on system. Pressure 42–67 psi. at pumping sta., 30–40 in outlying districts. Pretreatment capac. 80 mgd., filters (16 units) 64, low-lift pumps 105, high-lift 102, filtered-water basins 14.5 mil.gal. Alum (mfd. at plant) dosage 0.7–4.2 gpg., avg. 1.1; Cl 0.15–0.8 ppm., avg. 0.35; residual Cl 0.02–0.1 ppm., avg. 0.06; avg. wash water 1.8% of water filtered; avg. filter run 72 hr.; avg. rate of wash 30″ rise per min. Turbidity reduced from avg. of 31 ppm. (max. 350) to zero, Fe from 0.25 to 0.04, 0 consumed from 3.1 (max. 11.2) to 1.2, avg. 37°C. count (24 hr.) per ml. from 175 (max. 1020) to 0.09 (max. 2), *Esch. coli* index from 4.7 (max. 70) to 0 in 50 ml. Avg. free CO_2, raw water 2.8. tap water 9.9; avg. pH 7.5 and 6.9. resp. Avg. dissolved solids, tap water, 110.6 ppm.; hardness 70 (max. 114). Steel anodes in 2 elevated tanks renewed and current increased from 3 to 3.5 amp.; tank interiors in good condition. Well (14″) sunk in Tahoe Park for irrigation and, if water potable, for reinforcing domestic supply to area. At original depth of 372′, water unpotable. Plugged at 241′ level and 1568 gpm. potable water obtained.—*R. E. Thompson.*

Santa Cruz (Calif.) Water Dept. Annual Report (1949–50). Rates increased about 40% to provide \$80,000 addnl. revenue to service bond issues for needed improvements. General-obligation bond issue, \$600,000, approved by electors. Outstanding bonds \$175,0000. Services 10,246, consumption 1470 mil.gal. Fixed capital \$2,-705,115, total assets \$3,017,806, reserve for depn. \$1,254,954, plant and equip. charged to net income and earned surplus \$1,518,972. Water revenue \$269,-234, total revenue \$269,552, operating

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expense \$85,211, depn. \$62,145, operating income \$122,197, interest \$9275, fire fund levy \$15,000, net income \$97,-922, from which bonds retired \$12,500. Cost of water per 100 cu.ft. sold 7.5¢, reduced from 9.2¢ in '47–'48. Avg. cost per meter repaired \$6.35. Capital expenditures \$133,571. Rainfall 31.7", normal 26.78". Water derived from coastal streams 910 mil.gal., San Lorenzo R. 742, wells 114, Branciforte Creek 4. Unmetered (municipal services) and unaccounted-for water 17%. Daily per capita consumption 115 gal. All water chlorinated, that from San Lorenzo R. filtered. Coliforms, avg. M.P.N. per 100 ml., San Lorenzo R. 442, before final chlorination 0. Of 10-ml. portions of treated water examd., coliform-pos. tubes exceeded 10% in 3 mo. and avgd. 7.8% for yr.; 6.1% samples had 3 or more pos. tubes among 5 examd. Samples which showed high coliform count came from reservoir and tank with defective roofs and from open reservoir. Water from latter chlorinated at outlet, following which coliforms absent.—*R. E. Thompson.*

Oak Park (Ill.) Water Dept. Annual Report (1949). Supply from L. Michigan through Chicago system. Facilities include 24-mgd. pumping sta. (pressure increased from 21.1 psi., avg., to 46.3) and 5-mil.gal. reservoir. Mains 109 mi., valves 1007, hydrants 1126, services 12,171, 100% metered. Underground leakage and meter under-registration 9%. No uncollectible accounts written off in 3 yr., and only \$30 in 8 yr. Estd. pop. 72,000, avg. consumption 5.97 mgd. (82.7 gpcd.), max. 10.85 mgd. Fixed assets \$1,448,-951.61, less depn. allowance \$1,156,-498.68, total assets \$683,715.75, total liabilities \$32,989.11, net worth \$650,-726.64, gain in '49 \$50,030.90. Revenue \$684,168.85, operation and maintenance \$318,527.27, including \$158,-751.56 paid to Chicago, transferred to

(Continued on page 48)

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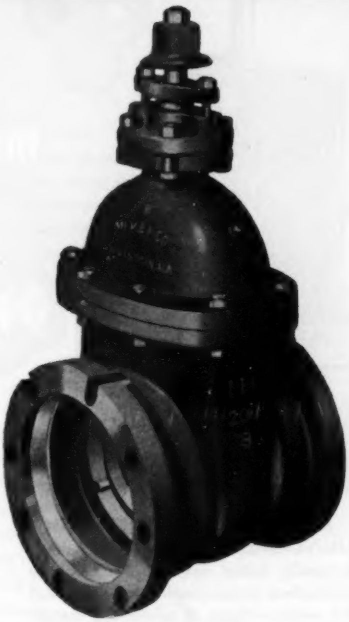

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(*Continued from page 46*)

corporate and other funds $316,835.28, net gain $48,806.30. Revenue per 1000 gal. 31.75¢. Operation and maintenance 14.79¢. Amt. paid to Chicago 7.38¢.—*R. E. Thompson.*

Indianapolis (Ind.) Water Co. Annual Report (1949). Gross revenue $4,137,764.80 (nonoperating $34,020.-04), $61,000 increase. Operating expense $2,881,958.66 (also $61,000 increase), including depn. $213,390.37 and taxes $1,103,279.94. Interest on bonds and miscellaneous expense $494,-362.22, dividends $435,247.61, transferred to surplus $326,196.31. Pop. supplied 480,000, customers 101,731, max. and avg. pumpage 68.5 and 52.16 mgd., resp. Mains 864 mi., hydrants 8190. Supply: 67.3% from White R., 30.5% from Fall Creek and 2.2% from wells. Gross addns. to plant and property $2,892,986, of which distr. system extensions $2,143,882. Constr. of 36-mgd., $2,700,000 addn. to White R. purif. plant under way. Plant assets $31,780,321.51, total assets $35,629,-659.40. Capital stock $6,084,900, long-term debt $16,725,000, reserve for depn. $2,677,986.08, total reserves $2,-801,200.87, earned surplus $4,155,-823.54.—*R. E. Thompson.*

Dubuque (Iowa) Annual Report (Year Ending March 31, 1950). First plant 1870, municipally owned since 1900. Supply from 8 artesian wells, 1300–1781′ deep and 6–16″ diam., and mine tunnel known as "The Level." Reservoir (3) capac. 10.33 mil.gal., standpipe 0.6, elevated tank 0.75. Pop. 49,527, mains 127 mi., valves 2456, hydrants 980, meters 10,-895. Total revenue $238,781, expenditures $280,782, including $127,149 for main extensions and other betterments; expenses exceed revenue by $42,001. Rates 5.4–22.5¢ per 100 cu.ft., monthly min. 63¢ (⅝″ meter) to $6 (6″), fire protection from $25-per-yr. min. for up to 200 sprinkling heads. Net profit $56,369, 2.7% of

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plant investment. Net plant value $2,223,594, no bonded indebtedness. General fund balance of $99,553. Revenue bond issue and substantial rate increase necessary to finance improvements contemplated for next 5 yr. ($430,000), which include feeder and distr. lines, repair shop and 2 elevated tanks. No hydrant rental. Water furnished free for municipal purposes and portion of salaries of municipal officers paid by department—these total about $75,000 per yr. Avg. consumption 4.16 mgd., 78 gpcd. No samples from distr. system contained coliforms in 10 ml. Alky. 276 ppm., hardness 294, F 0.6, pH 7.9. Cost per 1000 gal. consumed 12.79¢. Water unaccounted for 14.77%. Avg. cost of operating cars and trucks 8.68¢ per mi.—*R. E. Thompson.*

Louisville (Ky.) Water Co. Annual Report (1949). Total revenue $2,999,907, total expense (including $16,160 interest) $2,009,489, net income $990,418, dividends $817,000, transferred to surplus $173,418. Increase in revenue during past 5 yr.—due entirely to increased sales, rates remaining same—has never equaled increased costs, hence net earnings have declined steadily. In Aug. '50, entire debt of $404,000 will be retired from sinking fund. Services 86,052. Supply from Ohio R. Capital stock held by sinking fund of city. Pop. 400,000. Filters: 14, 6 mgd.; 12, 3 mgd. Storage 189 mil.gal., of which 58 pure water. Hardness of delivered water 75–95 ppm., of river water 80–160. Na aluminate substituted for alum during low-turbidity periods, reducing soda ash required for softening and effecting overall saving. Usual algae tastes successfully combated with prechlorination and C. Phenolic tastes more and more troublesome. ClO_2 very effective for latter, avg. cost $2.57 per mil.gal. App. for removing lime deposits from 6" feed pipes consists of air motor, exhaust outlet hose and

(*Continued on page 52*)

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usual boiler tube cleaning tools. Avg. pumpage 64.09 mgd., max. 81.6. Pumping cost per mil.gal raised 100′: Riverside Sta. (chiefly elec.) $4.55, Crescent Hill Sta. (steam) $6.97, booster elec. and hydraulic pumps $23.09. Cost of purif. $15.90 per mil.gal., of which $9.18 for chemicals. Avg. filter runs 40–51.8 hr., wash water 1.89%. Prechlorination used to lengthen filter runs and activated C to combat taste and odor. Solid CO_2 substituted for CO_2 from oil furnace for recarbonation. Equip. rental included in price of CO_2 purchased. Cost per lb. CO_2 fed, 3.1¢, compared to 8¢ by former method. Avg. dosage and cost of chem. per mil.gal.: alum 132.4 lb., $2.44; lime 260.3 lb., $1.77; prechlorination 35 lb., $1.14; postchlorination 5.1 lb., $0.18; ammonium sulfate 4.5 lb., $0.28; soda ash 200.3 lb., $3.02; C 20.3 lb., $1.32; Na aluminate 17.5 lb., $1.29; CO_2 13.1 lb., $0.31; Na chlorite 3.3 lb., $2.57. Wash water cost per mil.gal. treated, regular $0.63, surface 0.05. Avg. turbidity reduced from 102 to 0, total hardness 116 to 91, total solids 293 to 181, odor 6 to 1.3, bacteria per ml. (37°C.) 2978 to 1.37, gas formers (100 ml.) 5017 to 1.4, coliforms (100 ml.) 4572 to 0.15; pH increased from 7.5 to 9.1; residual Cl in delivered water 0.55. Mains 802 mi., services 93,091 (100% metered), hydrants 3943. Avg. consumption 59.93 mgd. (150 gpcd.), 83% registered on customers' meters. Revenue per 1000 gal. 13.8¢, operating expense 9¢, net income 4.8¢. Main constr. costs $1.38 per ft. for 1.5″ to $5.18 for 12″. Avg. cost of inspecting and testing meters 85¢, of setting and removing meters $1.70. Avg. meter readings per man per day 192, cost per reading 11.6¢. Service discontinued for nonpayment 414. Fixed capital $26,058,320, total assets $27,590,549. Surplus $12,680,839.—*R. E. Thompson.*

Augusta (Me.) Water Dist. Annual Report (1949). Fixed assets $2,055,316.23, total assets $2,117,464.69, bonds payable $456,500, depn. reserve $586,249.85, debt retired through surplus $643,500, earned surplus $373,909.03. Water service revenue $132,379.86, operating expense, including taxes and depn., $94,335.56; net operating revenue $38,044.30; interest on long-term debt $15,024.17; bonds retired $25,000; net loss closed to surplus $3,714.88. Highest demand in history depleted Carleton Pond, and auxiliary supply, L. Cobbosseecontee, resorted to in Nov. Since '41, consumption by larger users increased over 50%. Avg. pumpage 2.77 mgd. Monthly Cl and lime dosages, resp., 5.67–8.47 and 14.1–43 lb. per mil.gal. Mains laid 9296′; total cost per ft. for 1, 2, 6 and 8″: $0.94, 1.57, 3.25 and 5.41, resp. Mains 418,289′, gate valves 812, services 3901, public hydrants 228, private hydrants 65. History of district included in report: Formed in '03

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to take over private company supplying water from Kennebec R., typhoid being prevalent at time. River supply abandoned in favor of present source in '06, chlorination adopted '23. Local storage 16 mil.gal. (more than week's supply), in addn. to several elevated tanks.—*R. E. Thompson.*

Detroit (Mich.) Dept. of Water Supply. Annual Report (Year Ending June 30, 1949). New record record max. pumpage 571.6 mgd. and max. hr. rate 878.4. Constr. program of \$35,000,000 adopted. Financing plans included rate increase of 14¢ per 1000 cu.ft., effective Feb. 14, '49, and \$10,000,000 bond issue. Latter defeated by voters. Operating revenue \$12,020,795, operating expense \$7,852,273, net operating income \$4,168,522, other income \$771,549, interest \$2,309,851, net income \$2,630,209. Total assets \$171,919,542, sinking fund \$23,663,425, bonds payable \$58,548,000, reserves \$47,179,081, total city equity \$64,548,832. Main and service leakage 4%, municipal unmetered and unaccounted for 9.85%, nonrevenue-producing pumpage 15.36%, supplied to suburban areas 18.56%. Avg. revenue per 1000 cu.ft. pumped 63¢. Delinquent balance, city accounts, \$63,763. Hydrants 29,667, services 497,880, 99% metered, mains 5217 mi., main breaks 459. Avg. cost of testing meters 13¢ (⅝″) to \$13 (8″), installation \$14.22 (⅝″) up, repairing damage by frost \$3.54 (⅝″) to 6.24 (1″), by hot water \$4.02 (⅝″) to \$28.98 (2″), by wear and tear \$3.40 (⅝″) to \$23.57 (12″). Shutoff and blowoff gates 30,253. Avg. pumpage 375.8 mgd. (155 gpcd.), 5.7% increase. Unusually high plankton counts, up to 4300 units, chiefly diatoms, necessitated high alum dosages. All 16,380 10-ml. portions of tap water tested coliform free; of 4649 samples collected from distr. system by Detroit Board of Health, 4 pos. Objectionable tastes absent in finished water; odor threshold about 1 (musty), both raw and filtered. Complaints totaled 750; taste 48, sickness 10, all unjustified; remainder dirty water, causes as follows: main breaks 33, hydrant operation 450, dead ends 19, local conditions (plumbing, hot-water tanks, etc.) 94, poor circulation 9, abnormal flow 36, unknown 51. All new and repaired mains disinfected. Avg. data, Water Works Park and Springwells Filter Plants, resp.: wash water 3.1 and 6.4%, filter runs 36 and 35 hr., rate 162 and 167 mgd., alum 11.7 and 11.3 ppm. (latter 0.6 ppm. per ppm. turbidity removed), prechlorination 0.9 and 1.12 ppm., postchlorination 0.19 and 0.13 ppm.; 37°C. agar counts, raw 16, finished 0 (both plants); coliforms (M.P.N.) raw 54, finished 0 (both plants); turbidity, raw 15 and 18, effluent 0.1 and 0.3 ppm.; plankton, raw 449 and 560, applied 90 and 119; effluent residual Cl 0.45 ppm. (both plants); pH, tap water, 7.6 and 7.4. Raw water common to both. Avg. hardness 95 ppm. Pitometer crews located leakage totaling 1.24 mgd. System serves 38 suburban cities, villages and townships and 3 out-county institutions. Pop. served 2,455,820, of which 604,820 suburban; area served 283.44 sq.mi., of which 143 suburban. Motor vehicle accidents reduced 43%, personal injuries 17% and accidental injury frequency 21%. Disabling injuries per 1,000,000 man-hr. 8.65, days lost per 1000 man-hr. 0.829. Rates per 1000 cu.ft.: first 10,000 cu.ft./mo. 92¢, next 90,000 74¢, over 100,000 62¢; monthly service charge 24¢ (⅝″) to \$53.28 (24″); min. bill \$1.64 per quarter: suburban, first 10,000 97¢, next 90,000 78¢, over 100,000 65¢. Service charge \$0.50–\$56.19, min. bill \$2.47. Gross operating revenue per capita \$4.97, per mil.gal. \$87.64, per 1000 cu.ft. revenue water 77.1¢; total production and fixed charges per 1000 cu.ft. revenue water 57.8¢.—*R. E. Thompson.*

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Wyandotte (Mich.) Dept. of Municipal Service. Annual Report (1949). Filter plant extension, housing 4 1-mgd. rapid sand filters, under constr. at cost of $161,002. Contract awarded for 42″ intake 1800′ long to secure supply from second channel of Detroit R., water of which conforms to U.S.P.H.S. standards. Tap water anal., in ppm.: dissolved solids 140.4, total hardness 114.7, bicarbonate hardness 85.6. Fixed assets, including unfinished constr., $2,543,093.63, depn. allowance $924,142.20, total assets $1,998,269.03, long-term debt $133,919, net equity $1,611,125.38. Operating revenue $197,706.08, operating expense $158,310.22, net operating revenue $39,395.86, net income $39,187.36. Pop. 38,000. Fixed capital investment, operating revenue and net operating revenue $66.92, $5.20 and $1.04 per capita, resp. Water pumped 1,693.16 mil.gal., max. pumpage rate 9 mgd., daily consumption per capita 122. Expenses and revenue per 1000 gal.: pumping 1.55¢, purif. 2.49¢, distr. 3.05¢, miscellaneous 2.26¢, total 9.35¢; operating revenue 11.68¢, net operating revenue 2.33¢, interest and other costs 0.52¢, net nonoperating revenue 0.51¢. Filter capac. 6 mgd., underground storage 1.4 mil.gal., overhead storage 0.5 mil.gal., pumping capac. 14.8 mgd. high service, 15 mgd. low service. Distr. losses 18.15% of water pumped. Mains 93.4 mi., valves 961, hydrants 757, meters 8650.—*R. E. Thompson.*

Scarsdale (N.Y.) Annual Report (1949–50). Estd. pop. 13,500. Water supply from L. Pocantico owned by New Rochelle Water Co., Bronx pipeline and Catskill Aqueduct of New York City and, under certain conditions, Croton Aqueduct. Distr. system owned by village. Pipelines 86 mi., hydrants 772, meters 3819, pumping sta. 2, standpipes 2. Rates $2.05 per 1000 cu.ft. (first block, majority of users) with 50¢ service charge per quarter for ⅝″ meter. Wholesale price increased about 5%, first change since '38. Avg. consumption 1.85 mgd., unaccounted-for water 8.5%. Plant and equip. cost $1,694,382, total assets $1,857,465, village equity $1,631,796. Of latter, $1,452,499 from operating revenue. Equity increased during yr. by $64,665 from operating revenue. Total revenue $221,573, operating expense $146,676, net income $74,897, balance of income $5462 after paying $10,232 interest on bonds, redeeming $40,750 of latter and capital outlays of $18,453. Outstanding bonds $209,250.—*R. E. Thompson.*

Lorain (Ohio) Water Works Dept. Annual Report (1949). Filter plant capac. 11 mgd. Elevated treated-water storage reservoir (4 mil.gal.) enables uniform operation. Avg. water treated in July and Aug. 8.60 and 8.65 mgd. Plant extension contemplated. Mains 124 mi., services 12,032, meters 11,777, hydrants 952, valves 1416. No waterborne disease ever traced to supply. Lab. examns. 6021. Pop. 55,000, avg. consumption 6.98 mgd., 119 gpcd., domestic use only 47.5 gpcd. Of water pumped, 75% billed. Receipts $298,935, estd. free water service to city $35,670, operation and maintenance $233,001, extensions and betterments $81,755, bonds retired $11,000, interest $5,060, total expenditures $334,816, cash deficit $35,881, bonded indebtedness $242,000. Free service to city almost exactly what city taxes would be if water works taxed. Chem. cost $5.48 per mil.gal., increase of $1.60. Dept. cannot continue to finance extensions entirely from surplus. Meter rental (15¢ per mo. for ⅝″ meter), domestic meter setting charge ($2) and charge for ¾″ service connection main to curb ($50) should be increased. Bacterial count, raw water, 17 to 18,000 per ml., avg. 1200; finished water, avg. 1. Avg. confirmed coliform concn., raw water, 790; finished water, 0.—*R. E. Thompson.*

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Erie (Pa.) Annual Report (1949). Improvements, costing $1,500,000, approaching completion—$700,000 water works bonds (1.75%) issued. Feeder main, 30″ diam. and 7200′ long, cost $225,000, required to distribute addnl. water from West Plant, capac. of which increased from 16 to 28 mgd. (35 in emergency) by 6 new 2-mgd. filters. During summer months, sprinkling restricted to 3 days per week. Fixed assets $10,559,883, total assets $11,967,345, bonds outstanding $1,386,000, investment and surplus $10,563,794. Water sales $1,113,450, total revenue $1,169,307, operation and maintenance $849,103, including interest $31,943, bonds retired $60,000. Operating cost, including interest and depn. $77.81 per mil.gal. Water furnished free to city $75,439. Avg. chem. dosages (lb./mil.gal.) Chestnut St. and West Side filter plants, resp.: Cl 2.73 and 5.63, C 1.91 and 2.31, NH_3 0 and 0.6; alum (gpg.) 0.40 and 0.34. Wash water 1.9 and 1.15% water filtered, resp. All 10- and 1-ml. portions of filtered water examd. for coliforms neg., bacterial count 0 (1 in Jan. at West Plant), turbidity 0, alky. 86.2–90.3 ppm. Avg. consumption 35.83 mgd. by estd. 148,000 pop., 242 gpcd. Mains 322 mi., hydrants 1765, gates 4939, services 36,690 (31,206 active), avg. cost of services laid $59.78, meters 1606 (5.15% of services). Gal. pumped per lb. of coal (Chestnut St.) 289, mean discharge head 264′. Supply to Chestnut St. plant from L. Erie through 60″ intake (36-mgd. capac.) terminating 5100′ from Peninsula shore in submerged crib with min. water cover of 22′. After 24-hr. plain sedimentation, water coagulated, filtered (16 rapid sand units, 2-mgd. capac. each) and chlorinated. West Plant intake, 72″ diam. (70-mgd. capac.) and 8745′ long, also terminates in crib with 22′ min. water cover. Distr. storage includes 2 reservoirs, 33- and 10-mgd. capac., resp.; 100,000-gal. elevated tank; and 300,000-gal. standpipe.—*R. E. Thompson.*

Arlington County (Va.) Water Dept. Annual Report (Year Ending June 30, 1949). Supply from Dalecarlia Filtration Plant, District of Columbia (operated by U.S. Engineers), through 20–36″ mains to reservoir at Minors Hill. Avg. consumption 10.71 mgd., max. 16.12. Water pumped into reservoir and to elevated tank and standpipes in different areas. Delinquent accounts $4,016.51, 0.005% of water sales ($771,089.23). Outstanding indebtedness $271,240 (sinking fund $195,173) plus $60,600 F.W.A. loan. Payment on latter semiannually, $17.50 per mil.gal. Sinking fund payments $51,250, interest $12,312. Revenue $940,524, expenditures $1,000,014, surplus to June 30, '49, $262,762. Cost of water purchased $195,338 ($50 per mil.gal.). Pop. served 130,000, meters 21,163 (100%), mains 282 mi., hydrants 1567, services 21.485. Min. domestic rate per quarter $4.50.—*R. E. Thompson.*

Portsmouth (Va.) Water Dept. Annual Report (1949). Supply from Lakes Kilby and Cahoon, capac. 750 and 1700 mil.gal., resp., watershed area 20 and 30 sq.mi., resp. Former only used in '49 and water wasted over spillways 4 times that pumped. On completion of $514,060 modernization program, financed from earnings, rated capac. of 2 filter plants 18.9 mgd. Stationary surface wash replaced by revolving type, with considerable saving in wash water. Filtered water storage 9.2 mil.gal. plus 1-mil.gal. elevated storage. Filtered water pumped to Portsmouth 3250 mil.gal., to Suffolk 362, wash water 88, total treated 3758. Chem. used: alum, lime (raw and filtered), C (raw and filtered), Cl vitreous phosphate (latter since June to reduce corrosion, particularly in hot-water tanks). Monthly chem. anal. data: raw water—turbidity 3–29, alky. 6–13, free CO_2 8–20, color 51–141, pH 6.0–6.4; finished water—turbidity 0, alky. 10–24, free CO_2 0–9, color 3, residual Cl 0.46–0.50, pH 6.5–8.4. Wa-

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ter unaccounted for: Portsmouth 11.6%, Suffolk 20%. Mains 1,644,016', hydrants 1160, meters 24,332. Operating costs $454,234.67; debt service $59,379.49; mains, hydrants, land, meters and boxes $170,421.35. Appropriation for filter rebuilding $574,524, expended $181,574.70, completion in '50. Revenue $800,869.99. Outstanding bonds $264,000 (interest $13,130), sinking fund $210,628.12, net debt $53,371.88. Value of works property $6,475,468.35, depr. $1,070,712.26, book value $5,404,756.09, actual value some $2,300,000 higher than this. Cost per 1000 gal.: operation and debt service 13.9¢, capital addns. 5.34¢ (excluding filter rebuilding), total 19.24¢. Revenue per 1000 gal. 23.65¢.—*R. E. Thompson.*

Richmond (Va.) Dept. of Public Utilities. Annual Report (Year Ending June 30, 1950). Pop. 231,000, customers 54,653, customers per mi. of mains 98.5, consumption 128 gpcd. Settling basins 2, 35-milgal. capac. each, filters 22, total rated capac. 66 mgd., aeration, reservoir storage 46 milgal., elevated storage 4.1 milgal. in 4 tanks, largest 2 milgal. Water treated 30.98 mgd. Avg. filter run 79.2 hr. Activated C applied to filters at beginning of run; addnl. amts. added at 24-hr. intervals; when dosage required exceeds 10 lb. per milgal., excess added before coagulant. Chem. used: before filtration—$CuSO_4$, Cl, CaO, alum, chlorinated copperas, C; after filtration—NH_3, Cl, CaO. Avg. turbidity reduced from 29.8 to 0.2 ppm. (max.: raw 258, filtered 1), color from 62.8 to 2.2 (max.: raw 290, filtered 6), alky. from 38.9 to 29.7, oxygen consumed from 5.18 to 1.97, 37°C. bacterial count per ml. from 1139 to 0.21 (max.: raw 20,000, filtered 4). Presumptive coliform tests on filtered water (100, 10 and 1 ml.) all neg. Mains 555 mi., hydrants 3318, active meters 55,115. Rates per 100 cu.ft.: city—6–16.7¢, monthly min. $1; county—6.5–32.5¢, monthly min. $2.10.—*R. E. Thompson.*

Aberdeen (Wash.) Water Dept. Financial Statement (1949). Operating revenue $249,790; operating expense $178,992; miscellaneous revenue $1353; operating income $72,151; net income after deducting interest ($27,890) and taxes, etc., $28,280; appropriation for bond sinking-redemption fund reserve $55,990; bond redemption $56,000. Fixed assets $3,292,877, total $3,609,784. Bonds (5%) outstanding $559,000, depr. reserve $1,274,845, surplus $1,338,976, including bond sinking and redemption fund reserve $28,000.—*R. E. Thompson.*

Chatham (Ont.) Annual Report (1949). Pop. served 23,700; suburban 2991. Supply from Thames R. filtered (pressure) and treated with chloramine. Consumption 3.94 mgd. (max. 6.42), 166 gpcd. Mains 57 mi., hydrants 333, meters 5909. Revenue $199,075, expenditures $125,708, including new constr. $40,234, excess revenue $55,105. Total assets $1,225,558; $52 per capita. Rates (net), domestic 28¢ per 1000 gal., industrial, etc., 10–18¢. Avg. alum dosage 1.9 gpg., Cl 1.9 ppm. River water turbidity as high as 1760 ppm. Total cost per 1000 gal. 7.07¢, revenue 11.1¢.—*R. E. Thompson.*

Oshawa (Ont.) Annual Report (1949). Total assets $815,679. Revenue $232,155. Expenditures include depr. $30,199, provision for capital constr. $20,000, debt charges $23,046. Surplus $10,767. Rates per 100 cu.ft. first 1000 cu.ft. per mo. 12.5¢, remainder 9¢; suburban 20¢ and 14.4¢, resp.—service charge 42.5¢ per mo. Pop. served 28,552; 6700 suburban. Supply from L. Ontario, filtered and chlorinated. Mains 67 mi., hydrants 290 (4.3 per mi.), consumers 7828, meters 6629. Consumption 3.54 mgd.—*R. E. Thompson.*

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William C. Gibson, educational director of sanitation field training at the University of North Carolina School of Public Health, has joined the faculty of the School of Public Health of the University of Michigan. As associate professor of public health engineering, he will be in charge of the undergraduate program in sanitary science and will assist with the graduate work.

A 20-year index to *Sewage Works Journal* has just been published by Garrard Press, Champaign, Ill. The volume covers volumes 1 through 20 (1928–1948) and sells for $4.50. It contains three separate sections, with listings by author, subject and geographic location.

A new high capacity chlorinizer with a capacity range of 100 to 6,000 lb. in 24 hours has been produced by Builders-Providence, Inc. Of fundamentally the same design as lower capacity models previously introduced, the apparatus has the visible gas flow feature which is standard for the line. In addition to the basic manual control, step control, automatic proportioning, semi-automatic or program control is available.

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"The power of a woman," which we're never supposed to underestimate, turns out to be not so much anyway—at least waterwise. At any rate, according to the December 1950 issue of Purdue University's *Sanitary Engineering News,* "to produce 1,000 mgd. of potable water from the sea by electrical methods would require twelve times the power output of Hoover Dame."

YOU think it's a long time between drinks! You should have been in Rangoon these past three years—through all that heat, too. It was only the other day that Burmese government troops finally recaptured the Gyobyu water works—the city's main water supply facility—from rebel forces that had occupied it for even more than a thousand and one days. Fortunately, Rangoonians don't often use anything as tame as water for drinking. But even so there must have been a good deal of discomfort, for we know people of Burma shave.

John C. Bumstead, associate editor of *Engineering News-Record,* has joined the staff of the Ohio River Valley Water Sanitation Commission in the capacity of assistant director. In addition to his work on the weekly magazine, for which he reported water treatment and waste disposal developments, he served with the Army in Brazil as chief engineer of an inter-American sanitation unit. Previous experience included work as assistant field engineer with the Tennessee Valley Authority and as assistant city engineer at Saratoga Springs, N.Y.

The eastern sales offices of the Dorr Co., formerly located at 570 Lexington Ave., New York, have been moved to Barry Place, Stamford, Conn., where the company's general offices are located. A branch office will continue at the New York address.

An unusual Christmas gift received by Dresser Manufacturing Div. employees last December was a share of common stock in the parent company, Dresser Industries, Inc. The stock, which was listed at 18⅜, was presented instead of the usual $10 check in order to give employees a sense of participation in company affairs from the ownership end.

A chlorine dispenser designed to provide low-cost, dependable sterilization for swimming pools is being offered by Fischer & Porter Co. The Ratochlor dispenser works on a dry vacuum, solution-feed principle.

A new nipple chuck for the threading of short nipples is being marketed by Ridge Tool Co., Elyria, Ohio. The chuck has been designed to fit any threading machine without special adjustment.

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think of Economy
backed by over thirty years of specialized experience
The Type M Single Stage Double Suction Pump illustrated is just one of the many in the extensive line manufactured by Economy Pumps, Inc. A general purpose pump, it is ideally suited to general water supply or heavy mill service. Case records show Economy Pumps operating for fifteen to twenty years without replacement of major parts. However, should repairs be necessary, all parts subject to wear are renewable.
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Economy Pumps Inc.
DIVISION OF HAMILTON-THOMAS CORP., HAMILTON, OHIO

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How to save a million dollars a day is something we'd particularly like to learn. So we sent for a book that promised to tell us how to do it —in 22 pages, under 6 simple headings, at a cost of $1 for a single copy, much less in quantity. Feeling that one million a day would be enough for a start, we asked for only one copy. And now we know how—by: (1) corrugated lines; (2) blots and blurs; (3) hesitation strokes; (4) erasure marks; (5) ink changes; and (6) handwriting types—we can do it. Only trouble is, the million we save isn't ours—it's the amount of the losses from bad checks throughout the country. If you're interested anyway, the publisher of the book is the Fraud Detection & Prevention Bureau, 2515 W. 82nd St., Chicago 29, Ill., and the title of the tome is "6 easy ways to recognize a bad check" by C. H. Fletcher. The close quote is ours, but we assume it really belongs.

Maurice A. Shapiro has been appointed assistant professor of sanitary engineering at the Graduate School of Public Health, University of Pittsburgh. Previously an engineering research associate with the American Public Health Assn., he has also served with the U.S. Public Health Service and the Georgia and Florida health departments.

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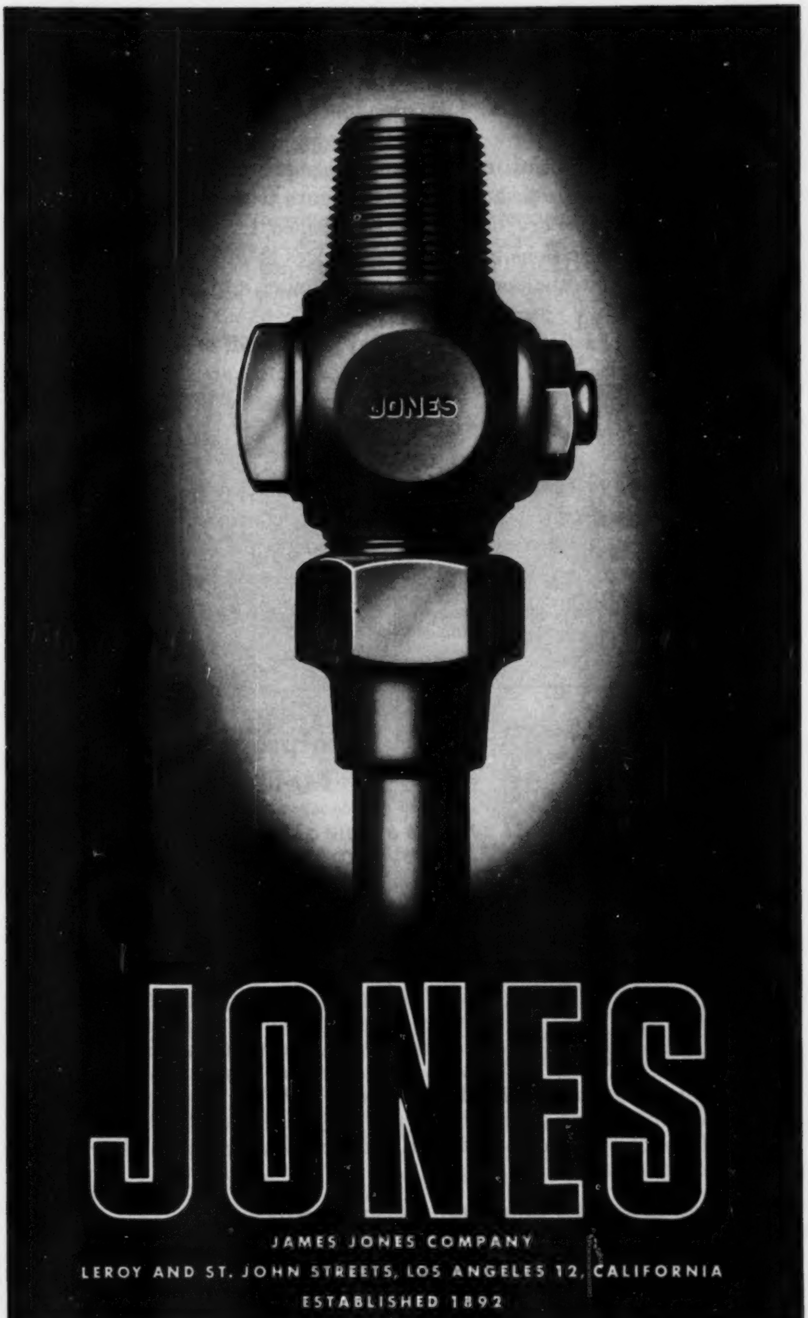
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Rumor hath it wrong again! This time the product of someone's warped imagination or hearing or humor was the report that the water supply of Birmingham, Ala., had been poisoned. Though it had absolutely no factual basis, the rumor—which originated sometime late in the day—kept the switchboards of the local newspaper, city hall and the police and water departments tied up for many hours with thousands of frantic calls. And though every official quickly denied the report, and though Birmingham radio stations broadcast assurances at fifteen-minute intervals all during the fright, the panic wasn't really under any measure of control until 7:00 P.M.

Having happened on New Year's Day, this could, of course, have been nothing but the argument of some henpecked hangoveree who didn't want to mix his drinks. And we could wish that it spread only because others also had hangovers.

Might it have been such a rumor, too, that prompted Philadelphia city employees to request that bottled water be provided at City Hall? Or was the pre-Christmas *United Press* story of Controller Joseph S. Clark's denial of the request merely a note to some municipal Santa Claus? Listen-in next election.

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Water supply defense news in the nation's press includes such varied items as the announcement by the Oak Ridge national laboratory of a faucet-attached radioactivity decontaminator, a proposal by the Engineers Joint Council for registering all unretired engineers up to age 70 as a pool from which the nation could satisfy its needs both military and civilian, and offer by the North Jersey District Water Supply Commission of two unused portions of its Wanaque Aqueduct—7-ft. concrete tunnels—as bomb shelters. Just about now would seem a good time to get one's house in order.

"Water! Water!" is the typical cry of the hospital patient—at least as we see him in the movies—but we never realized that his extreme thirst was contagious. How else explain the fact that Bertha Scott of Hartford, Conn., while visiting a patient at the hospital there, called out three fire companies when she wanted a drink? Her explanation that she "pulled the red handle to get a drinking cup" was accepted by the firemen, but we who know how much you can want water, wonder.

F. W. Beard, engineer of Freese, Nichols and Turner, has been admitted to partnership in the Houston, Tex., consulting firm.

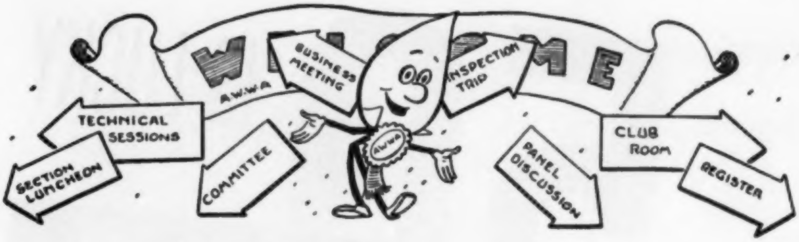
Service Lines

Six safety training booklets, entitled "Psychology of Safety in Supervision," have been issued by the National Safety Council. Written by J. L. Rosenstein for foremen and supervisors, the booklets are available from the council, 425 N. Michigan Ave., Chicago 11, Ill., at a cost of $1.80 per set, with discounts for council members and for quantity orders.

A series of folders describing the various grades of Carlon plastic pipe and tubing are obtainable from Carlon Products Corp., 10125 Meech Ave., Cleveland, Ohio. The general brochure and Catalog EF will be of greatest interest to those in the water supply field.

"Lead in Modern Plumbing—Why, Where, How It Is Used" is a 24-page booklet published by Lead Industries Assn., 420 Lexington Ave., New York 17, N.Y. In addition to photographs of typical installations, the booklet includes data an dspecifications for lead pipe and calking lead. The latter are the same as those included in A.W.W.A. specifications 7D.1.

Expansion joints offered by Dresser Mfg. Div., Bradford, Pa., are the subject of a descriptive booklet available on request. Single and double-end joints with or without a limited movement feature are stocked in 3-in. id. to 24-in. od.,. but larger sizes can be furnished on request. The leaflet, entitled "Expansion Joints by Dresser," offers descriptive matter, specifications, drawings and installation instructions.



Section Meeting Reports

Minnesota Section: The 34th Annual Convention of the Minnesota Section was held at the Hotel St. Paul, St. Paul, Minn., September 6–8, with 177 persons registered.

The morning of the 6th was devoted to registration and to inspection trips to the St. Paul meter repair shops, maintenance, repair and storage yards, and the general offices, as well as the meeting of the many committees. A luncheon meeting of the trustees preceded the formal opening of the sessions.

The Convention was formally convened after an appropriate address of welcome by Mayor Edward K. Delaney and Commissioner Milton Rosen, member of the local water board. Following a response by Chairman Mellen, the technical program began with an interesting paper by W. D. Hurst, city engineer of Winnipeg, Man., on "Water Supply Problems During Floods." As chairman and director of operations of the Flood Control Committee, the author was empowered to take any steps necessary for the protection of life and property and the alleviation of distress during the emergency period. This lasted from April 21 to June 10 and caused untold hardships and suffering to the city when the Red River overflowed its banks and flooded much of the city to a maximum depth of 12 ft., necessitating rapid evacuation of over 100,000 persons in less than five days. Measures taken to maintain and preserve the water supply system and avoid serious epidemics made a highly interesting subject—full of human interest and objective lessons. Discussions of flood conditions in the Dakota areas were offered by R. M. Jenson of Grand Forks, N.D., Col. Yoder of the Corps of Engineers, and others. Otto E. Brownell, public health engineer, spoke on the result of three years' operation under the Water Supply Rating System used in Minnesota, and strongly advocated its adoption as a national standard.

The second day of the convention opened with a breakfast meeting of all past-chairmen present. Following a business meeting, Charles R. Podas

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discussed "Proposed Improvements for the Minot, N.D., Water Plant"; W. C. Thompson, chemist of the Northern States Power Co., read a paper on the "Causes and Control of Corrosion"; William Yegen, superintendent of Bismarck, N.D., discussed "Stabilization of Water"; and Harry A. Faber of the Chlorine Institute, New York, gave a "Summary of Chlorination Principles and Practices." The day's session closed with a very interesting question and answer period, led by George J. Schroepfer, professor of sanitary engineering at the Univ. of Minnesota.

Friday's technical sessions consisted of a panel discussion on "Well Problems," led by C. F. Wimer, superintendent of water at Hastings, Minn., and "Distribution Problems," led by George Troman, Mandan, N.D. E. L. Filby of Kansas City closed the session with a well timed and received paper on public relations.

A complimentary luncheon was served the delegates at the St. Paul Water Department's Park, after which there was an inspection tour of the water softening and pumping plant. The convention closed with a most successful banquet, at which time announcement was made of the establishment of the "Finch Cup" in honor of Ronald M. Finch, who retired as Section Secretary after 24 years' service.

LEONARD N. THOMPSON
Secretary-Treasurer

Iowa Section: The meeting of the Iowa Section at Des Moines on October 26–27 was the most successful since the reorganization of the section in 1946. Of the 242 total registered, 97 were water works employees representing 49 municipalities. Engineers, instructors and geologists numbered 34; contractors and manufacturers representatives 68; and ladies 43.

The meeting was opened by Chairman George Nelson, and Mayor A. B. Chamber welcomed the group. Following a short session, all interested visited the Des Moines Water Works in order to inspect the new softening plant. The weather was perfect and all enjoyed the beautiful grounds and filter plant.

In the afternoon, M. K. Tenny of Des Moines told of his experience in sterilizing new water mains and an interesting discussion followed. A panel discussion on "Taste and Odor Control" was led by Leo Louis of Cedar Rapids, who described the taste and odor difficulties which Cedar Rapids experienced this summer. John Strang of Wallace and Tiernan Co., Joseph G. Filicky of West Virginia Pulp and Paper Co., John G. Matarese of Mathieson Chemical Co. and Victor Hann of Welsbach Corp. then offered their versions of how their companies' particular products could have alleviated the difficulty. The claims and counter-claims resulted in a lively and interesting session.

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The final paper of the afternoon was read by G. H. Hershey, Iowa State Geologist, who enumerated the activities of the Water Resource Commission and talked of the great amount of work still ahead before control could be effected.

On Friday morning, Mark Driftmier of Burlington led a panel discussion on "Office Methods and Equipment." C. E. Lapham of the Burroughs Adding Machine Co. told an interesting story of the development of the billing machine and J. F. Dondell of the Addressograph-Multigraph Co. explained how mechanical addressing equipment could be used in many ways to lessen the work in every water works office. Vernon Kneer, consultant, of Alvord, Burdick and Howson, read a paper on construction trends, pointing out how rising costs demanded better construction methods and improved materials.

William L. Hassett, prominent bond attorney from Des Moines, urged the adoption of uniform records, so that a better comparison might be made of the ability of communities to retire revenue certificates. He emphasized the importance of setting rates high enough before contracting debts. W. R. Gelston, superintendent of Water Works at Quincy, Ill., discussed his experience with albestos-cement pipe. His paper is an excellent and most comprehensive evaluation.

After lunch, the section was again called to order by Chairman Nelson, who then turned the meeting over to P. F. Morgan of the University of Iowa and his panel of experts to answer the questions which had been dropped in a question box on display at the registration desk. The questions asked were timely and serious, the answers excellent, and all agreed that the innovation should be continued another year.

Entertainment was provided at both the smoker on Thursday evening and the banquet on Friday evening. The manufacturers' representatives played the role of hosts at the smoker, and everyone present appreciated their efforts.

H. V. Pedersen
Secretary-Treasurer

Southwest Section: The Southwest Section held its 39th Annual Meeting in New Orleans, La., October 16–18, with John E. Morrill, secretary of the New Orleans Sewerage & Water Board, serving as General Chairman. A total—and record—registration of 795 was attained.

A well-balanced program was developed by John H. O'Neill's committee and a feature item on it was a luncheon address, "It Affects You," delivered by A.W.W.A. President W. Victor Weir. During the meeting President Weir presented the Southwest Section Membership Cup to Arkansas, the winner for the second time.

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Edward R. Stapley, Oklahoma A&M College, presented one of his inimitable breakfast programs entitled "Stratosphere Trip in Stratocruiser: Texarkokla."

On the technical side, a panel on "Getting Your Money's Worth" was led by W. Victor Weir. The subjects discussed included determining the water department's needs and program priorities; defining the number, kind and quality of units (plans, specifications, requisition); procurement (office equipment, personnel, procedure, paper work, forms); and installation and use of materials (stock keeping, transportation, personnel). Taking part in the discussion were: Homer A. Hunter, construction engineer of Dallas, Tex.; Albert R. Davis, superintendent, Austin, Tex.; and M. B. Cunningham, Section Director, Oklahoma City, Okla.

"Fluoridation of Public Water Supplies" was presented by Franz J. Maier of Washington, D.C. R. M. Dixon of Dallas, Tex., discussed "Construction Cost Reductions Through Improved Plans, Specifications and Contract Documents." An analysis of the "Relative Resistance of Coliform and Enteric Pathogens in the Disinfection of Water Wells with Chlorine" was offered by Paul Kabler, Cincinnati, Ohio.

A panel led by F. L. McDonald considered "Water Resources and Control Measures in the Southwest Section Area." Members taking part in the discussion included: R. C. Baker, Arkansas; Paul H. Jones, Louisiana; M. B. Cunningham, Oklahoma; and Marvin C. Nichols, Texas.

New Orleans, in her characteristic manner, furnished fine entertainment which included a buffet supper, a harbor trip on the steamer *President* and many other interesting events for the ladies and gentlemen in attendance.

The Water and Sewage Works Manufacturers Association provided the closing banquet and dance with 600 in attendance.

Bill Orchard of Wallace & Tiernan Co. made a colorful Fuller Award presentation to John H. O'Neill his old classmate and now director of the Division of Public Health, Louisiana State Board of Health.

At the banquet, the Egmont S. Smith Scholarship Fund Award was presented by Robert Harding to Larry Embree, son of Mr. and Mrs. Lon Embree of Magnolia, Ark.

L. A. JACKSON
Secretary-Treasurer

Arizona Section: A registration of 194 members and guests marked the 1950 Fall Conference of the Arizona Section at its meeting in Tucson, Nov. 30–Dec. 2, at the Pioneer Hotel. Members and guests attended a No Host Dinner at the La Jolla Club the first evening, and special entertainment was provided for the section guests.

Chairman George Marx presided over the Friday morning technical session which was opened by Mayor J. O. Nieman's welcome to the dele-

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gates. H. R. LaFortune, manager of purchases and stores for the Sacramento Municipal Utility Dist., addressed the group on the subject of "Purchasing Material," outlining the basic requirements of a properly designed and staffed purchasing department. He also discussed a stock reorder system based on perpetual inventory and pointed out the desirability of anticipating requirements. M. T. Bramman, district sales manager for James B. Clow & Sons at Los Angeles, discussed "Cement Joints, Their Cost, Experience and Acceptance."

At a meeting of manufacturers' representatives, John Mapes of R. W. Sparling, Los Angeles, was elected chairman of the group to serve through 1951.

Section secretary Helen Rotthaus presented to the members the Hill and Henshaw Cups, won by the Arizona Section for membership growth and meeting attendance during 1949.

The afternoon technical session was devoted to a panel discussion, presided over by Director G. E. Arnold of the San Diego Water Dept., dealing with the various aspects of a utility's public relations. Participants were Leigh O. Gardner, engineer of Yost & Gardner, Phoenix, who discussed the

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problems of the utility in its relation to the consulting engineer; Justice Evo DeConcini, of the Arizona Supreme Court, who discussed liabilities; John T. Kimball, vice-president of Central Arizona Light & Power Co., who outlined CALAPCO's successful management-employee program; Warren Hunter, chief engineer of the Fisher Contracting Co., Phoenix, who discussed some of the problems confronting the contractor in his relation with the utility; and J. Kenneth Potts, district sales manager, of the Mueller Co., Los Angeles, who concluded the panel discussion with his talk on "Utilities and the Manufacturer." The entire afternoon's panel was met with enthusiastic interest and spirited discussion.

John Mapes acted as toastmaster for the Friday banquet at which A.W.W.A. Vice-President A. E. Berry brought greetings from the Association and discussed recent activities of A.W.W.A. Bob Bale entertained guests with a humorous dinner talk, and concluded with a serious and interesting discussion of the effects of atomic bombing and possible defense against the bomb.

Vice-Chairman Stuart Henderson presided over the Saturday morning technical session, which opened with a film showing the use of mobile equip-

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ment in sewer maintenance, presented by the Los Angeles Dept. of Water & Power. Also shown were films from the cities of Tempe and Mesa, showing recent water extensions and additions.

Charles Trygg, sanitary engineer with the Arizona State Dept. of Health, discussed "Plumbing Cross Connections," and listed precautions that should be taken to guard against improper plumbing. Harvey Ludwig, of the University of California, discussed the "Role of Water Works in Disaster Relief," and pointed out that the two basic considerations involved in the supply of water to a community, in normal times as well as in times of disaster, are quantity of supply and safety of supply. He outlined steps for pre-disaster preparations, disaster relief operations and measures directed against contamination by sabotage or direct enemy action.

The Saturday luncheon, presided over by Chairman George Marx, was devoted to consideration of section business. An amendment to the Constitution was adopted, providing for one instead of two meetings a year for the section, to be held in the spring. Committee reports were given, including a report of the Committee on Schools and Certification. Harry Jordan, Sanitary Engineer with the Arizona State Dept. of Health, announced that plans were under way for a training program of operators, utilizing a correspondence course in conjunction with regional schools.

The Saturday afternoon session was devoted to a panel discussion of equipment maintenance and operation, with H. Arthur Price of the Los Angeles Dept. of Water and Power acting as moderator. Maintenance of sewer and water equipment was discussed by Dario Travaini, superintendent of water and sewers for Phoenix. M. J. Shelton, of the La Mesa, Lemon Grove and Spring Valley Irrigation Dist., La Mesa, Calif., discussed the use of mobile telephone communication in the operation of a water utility. "Sand Traps in Domestic Water Supplies" was discussed by Tom Nesbitt of the Mesa Water Dept., and Harold Yost discussed "Lubrication of Domestic Water Pumps." George Sopp, general superintendent of meters and services for the Los Angeles Dept. of Water & Power, discussed the importance of consumer metering. As with the previous day's panel program, considerable interest was shown in the afternoon's discussion by the large number of members in attendance at the session.

The conference concluded with the Saturday Dinner-Dance, presided over by Program Chairman Clark Webb. Informal entertainment was provided the guests during the dinner hour.

HELEN ROTTHAUS
Secretary-Treasurer

Wintroath Pumps, manufacturer of vertical turbine well pumps used largely for irrigation, has become a wholly owned subsidiary of Worthington Pump & Machinery Corp.

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Stanley Eng. Co.
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Ward & Strand
Weston & Sampson
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Whitman, Requardt & Assoc.

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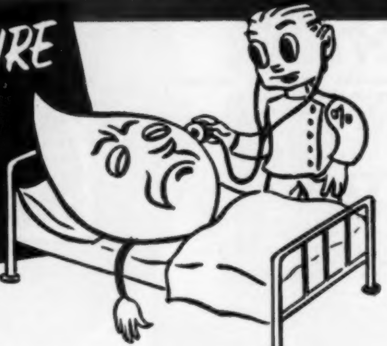
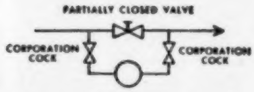
CHLORINE DIOXIDE TREATMENT

A PAINLESS CURE for a Sick Water Works





For use in by-pass around partially closed gate valve acting as a variable orifice to maintain a disinfecting residual while main is in use.

Discovery of contamination in the mains was mighty disturbing to a certain New England town of 15,000 people, extremely proud of its pure water supply. But the cure was simple and sure — %Proportioneers% Chlorine Dioxide System in ten days entirely eliminated the contamination while the mains were in use. In addition, the chlorine dioxide "saved face" for the water works since the treatment was completed virtually unbeknown to the water users.

TREATMENT: %Proportioneers% hydraulically operated Chem-O-Feeder, complete with Chlorine Dioxide Generator, was easily installed as shown in the diagram. No electricity or other outside power was required. A residual of 1 ppm as measured with O. T. was established in the mains and gave an actual residual of 2.5 ppm Cl and ClO_2 — without noticeable taste or odor. After 10 days, tests proved the sterilization complete, and the treatment was discontinued.

TODAY, in peace or war, pure water is a "must"! Every water works needs this emergency sterilization equipment. %Proportioneers% Chlorine Dioxide System is the ideal unit . . . it's complete, ready for instant use: to sterilize new mains, to eliminate contamination, to meet the emergencies of war. Investigate now, while equipment is still available. Write for bulletins.

%Proportioneers, Inc.% 365 Harris Ave., Providence 1, Rhode Island.

% PROPORTIONEERS, INC. %

A complete Buyers' Guide to all water works products and services offered by A.W.W.A. Associate Members appears in the 1950 Membership Directory.


There are
more ways than one
to get rid of
IRON AND MANGANESE
Iron and manganese are unpleasant impurities in water. They cause stains that interfere with industrial processes, and also make the water undesirable for household use.
Now Permutit's modern equipment eliminates these two water nuisances. You can remove iron and manganese in any of three ways: by base-exchange; by aeration, settling and filtration; or by oxidation through manganese zeolites. Find out which is best for your community . . . write for full information to The Permutit Company, Dept. JA-2, 330 West 42nd Street, New York 18, N. Y., or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.
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